Appendix N

Underwater Noise Assessment

Liberty Natural Gas, LLC
28-August-2014

Underwater Noise Impact Assessment

Port Ambrose Deepwater Port License Application

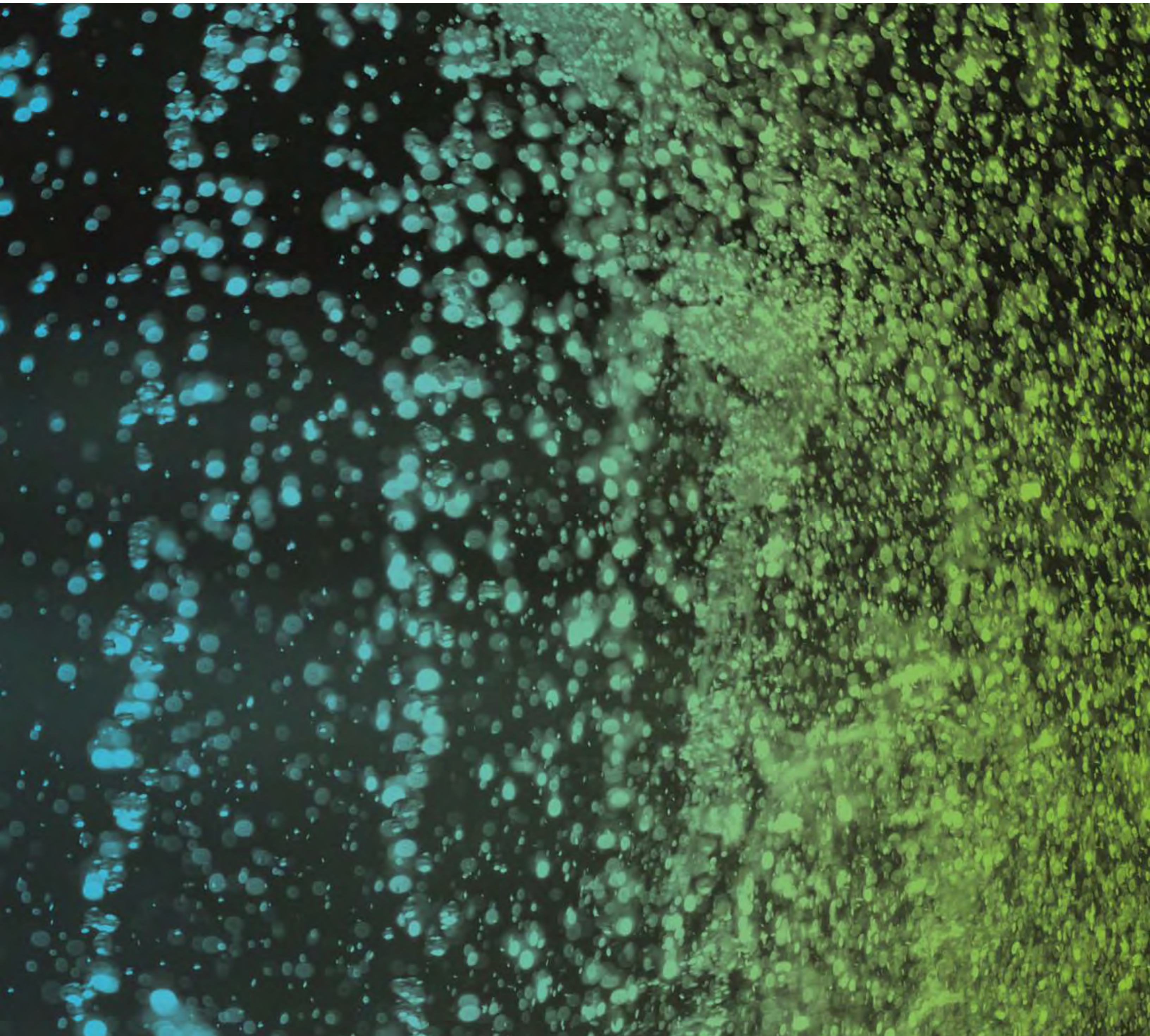


Table of Contents

List of Tables

List of Figures

List of Appendices

Glossary

Ambient sound	Background environmental noise not of direct interest during a measurement or observation.
dB	Decibel, unit used in the logarithmic measure of sound strength.
dB_{peak}	Peak sound pressure over the measurement period, expressed in dB re 1 μPa.
dB_{rms}	Root mean square sound pressure over the measurement period, expressed in dB re 1 μPa.
Hz	Hertz. The number of cycles per second and refers to the frequency of the particular noise.
M-weighting	Frequency weightings designed to best reflect the hearing sensitivity of marine mammals, similar to the use of the A-weighting for measuring noise impacts on humans. Noise levels for low frequency cetaceans are expressed in decibels using the Low Frequency M-weighting function, annotated as $dB(M_{lf})$.
Pa	Pascal, the international standard unit of sound pressure.
PTS	Permanent Threshold Shift. Irreversible and permanent reduction in auditory sensitivity.
SEL	Sound Exposure Level. Sound energy over the measurement period expressed in dB re 1 $\mu Pa^2 s$. SEL is commonly used for impulsive underwater noise sources such as impact pile driving because it allows a comparison of the energy contained in impulsive signals of different duration and peak levels. The measurement period for impulsive signals is usually defined as the time period containing 90% of the sound energy.
SPL	Sound Pressure Level. The sound pressure averaged over the measurement period, expressed in dB re 1 micro Pascal (μPa). Continuous noise sources such as vibro-piling and dredging are commonly characterized in terms of an SPL.
SL	Source Level. The intensity of underwater noise sources is compared by their source level, expressed in dB re 1 μPa for SPLs and dB re 1 μPa2s for SELs. The source level is defined as the sound pressure (or energy) level that would be measured at 1 meter from an ideal point source radiating the same amount of sound as the actual source being measured.
TTS	Temporary Threshold Shift. Short-term reversible reduction in auditory sensitivity. TTS will be gradually reversed upon removing exposure to the high noise levels that cause the change in hearing sensitivity.

Executive Summary

This report presents an assessment of impacts from underwater noise associated with construction, operations, routine maintenance, decommissioning and unplanned events from the proposed Port Ambrose Deepwater Port to be located in the New York Bight. The purpose of this assessment is to determine if a species listed under the Endangered Species Act (ESA) as endangered or threatened, or marine mammals protected under the Marine Mammal Protection Act (MMPA) could potentially be impacted by underwater sound generated by the proposed Project.

Liberty Natural Gas, LLC (Liberty) is proposing to construct, own, and operate a deepwater port, known as Port Ambrose (Port Ambrose, or the Project) in the New York Bight. In-water construction of the Project is scheduled to be completed during a 10 month period in 2016, with the first delivery of natural gas planned for December.

Underwater sounds will be generated during the construction, operations, routine maintenance and decommissioning phases of the Project. Offshore sound could also be generated in the event of an unplanned incident. Offshore construction of the Project will involve the installation of two Submerged Turret Loading buoy (STL buoy) systems and two offshore subsea lateral pipelines (Laterals) that will be connected to a subsea natural gas mainline (Mainline) which will connect to an existing gas pipeline.

Potential sources of underwater sound during the construction phase include sounds from suction piling (or impact piling, if deemed necessary), pipeline installation, interconnection and lowering/backfilling. Although underwater sound measurements of suction pile installations are not available, it is expected that the noise from this method of anchor placement would be negligible relative to other construction methods because the only noise source is the suction pump (Spence et al. 2007). All impulsive sounds are removed using this approach (CSA Ocean Sciences Inc. 2014). In the unlikely event that the alternative method of impact piling is needed, it is anticipated to be a much higher energy source of underwater sound during the construction phase of the Project.

Operation of the Port will consist of LNG regasification vessels (LNGRVs) approaching and mooring at the Port, before regasifying LNG to deliver natural gas over an anticipated period of 5-16 days per shipment. The highest-energy source of underwater sound during the operation phase will be from vessel transits near the Port and from mooring activities. The Project is to be constructed approximately 30 miles offshore of the Port of New York and New Jersey, which is considered the third busiest port in the United States. Vessel sounds during operations will result from propeller cavitations and propulsion, in addition to flow noise from water dragging across the hull and bubbles breaking in the wake. The dominant sound source from vessels is propeller cavitations with noise intensity dependent upon size and speed of the vessel. Noise impacts from LNGRVs are expected to be comparable to those generated by common and existing vessel traffic in the New York Bight. Underwater sound generated from routine maintenance, decommissioning and unplanned events will be similar, but shorter in duration, to those of the construction and operation phases of the Project.

Several species listed as endangered or threatened under the ESA and/or protected under the MMPA could occur in the vicinity of the Project, as identified by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) in letters to Liberty and the United States Coast Guard (USCG), and the United States Department of Transportation Maritime Administration (MARAD).

Underwater sound source modelling for the construction and operation of the Project has been undertaken by JASCO Applied Sciences, and results are detailed in their report Port Ambrose Deepwater LNG Terminal – NOAA Criteria Edition (2014). We have summarized the results of that report as relevant to our noise assessment. Sound levels have been assessed against criteria derived from U.S. policy and recent guidance concerning marine fauna hearing. For example, NOAA's Draft Guidance for Assessing the Effects

of Anthropogenic Sound on Marine Mammals (2014) is used for assessing the potential impacts of underwater sound sources on marine mammals.

For this impact assessment, risks to marine species potentially impacted by exposure to anthropogenic sound sources from the Project were assessed and ranked using objective criteria. NOAA (2014) suggests that qualitative factors such as exposure duration and frequency of exposure be considered when undertaking an impact assessment, in addition to comparison of predicted levels with objective noise criteria. We have included such factors in our assessment.

Because impact piling was assessed to have the highest potential for sound generation associated with the proposed Project, a technical feasibility study was conducted to determine if suction pilling is a possible alternative to impact piling (Moffatt and Nichol 2014). According to the Design and Installation Concept Verification study done by Moffatt and Nichol (2014), it is expected that the anchors can be installed in the sandy ground conditions and water depths anticipated at the Port Ambrose deepwater port site using suction piles.

Because suction piles will be used during the construction phase of the Project, a low level of risk has been identified for cetaceans, sea turtles, and fishes from sound generated by pile placement. Operational, routine maintenance and decommissioning activities are also expected to have a low level of risk to protected marine fauna because vessel noise is expected to be comparable to that generated by common and existing vessel traffic in the surrounding area and because animals have the ability to move away from potential sound sources.

In addition to suction piling, additional mitigation strategies have been identified which will be adopted as part of a reasonable and prudent approach to further minimize risk to protected species. With an appropriate combination of these mitigation strategies in place, the risk of sound sources causing harassment or harm to marine mammals, sea turtles, and fish species is further reduced.

1.0 Introduction

1.1 Objectives of the noise assessment

Liberty is proposing to construct, own, and operate the Port Ambrose deepwater port in the New York Bight. The purpose of this Noise Assessment is to determine if a species listed under the ESA as endangered or threatened, or marine mammals protected under the MMPA could potentially be impacted by sounds produced from the proposed Project.

This assessment will include a description of the proposed Project and any underwater noise sources generated by Project activities; current information on the abundance and distribution of protected marine species in the vicinity of the Project; an analysis of the potential direct and indirect effects of underwater sound from the proposed Project; and identification of proposed measures to avoid, minimize, and mitigate anticipated impacts related to underwater sound from the proposed Project.

The objectives of this assessment are to describe how the actions proposed by the Project may affect ESA or MMPA listed marine mammals, turtles and fish, as designated by NOAA's National Marine Fisheries Service (NOAA Fisheries) Office of Protected Resources (OPR) and United States Fish and Wildlife Service (USFWS) who, in conjunction with the USCG, and MARAD, will evaluate the potential impact of this Project on protected marine species and their critical habitat. This document is intended to provide information and support to the above agencies in order to consult with NOAA Fisheries OPR for the issuance of a Biological Opinion (BO) that will assess the proposed impacts of the Project and its potential to impact protected marine species as part of the NEPA process and ESA Section 7 Consultation Process.

1.2 Project overview

Port Ambrose is similar in design to two offshore Liquefied Natural Gas (LNG) ports near Boston, Massachusetts and an approved port near Tampa, Florida. The Project consists of two basic sets of components: two STL Buoy systems and an offshore pipeline system. The STL Buoy systems (collectively, the Port) will receive and transfer natural gas from purpose-built LNGRVs to the pipeline system (Figure 1-1). Two offshore Laterals will be connected to a subsea natural gas Mainline (collectively, the Mainline) which in turn will interconnect to an existing gas pipeline owned by the Transcontinental Gas Pipe Line Company (Transco) for eventual transfer to shore.

The STL Buoy systems will be located in water depths of approximately 103 ft (31 m), in federal waters; approximately 16 nautical miles (30 km) off Jones Beach, New York; approximately 25 nautical miles (45 km) east of Long Branch, New Jersey; and approximately 27 nautical miles (50 km) from the entrance to New York Harbor (Figure 1-2). Natural gas will be delivered from LNGRVs through the STL Buoy systems and Laterals into a buried, 19 nautical mile (35 km) subsea Mainline, which will connect offshore with the existing Transco pipeline for delivery to shore. When not in use, each STL Buoy will be lowered to rest on a landing pad on the ocean floor.

Port Ambrose is designed solely for the import of natural gas. Liberty will focus its deliveries through Port Ambrose during peak winter months to provide additional supplies of natural gas to downstate New York during periods of peak demand.

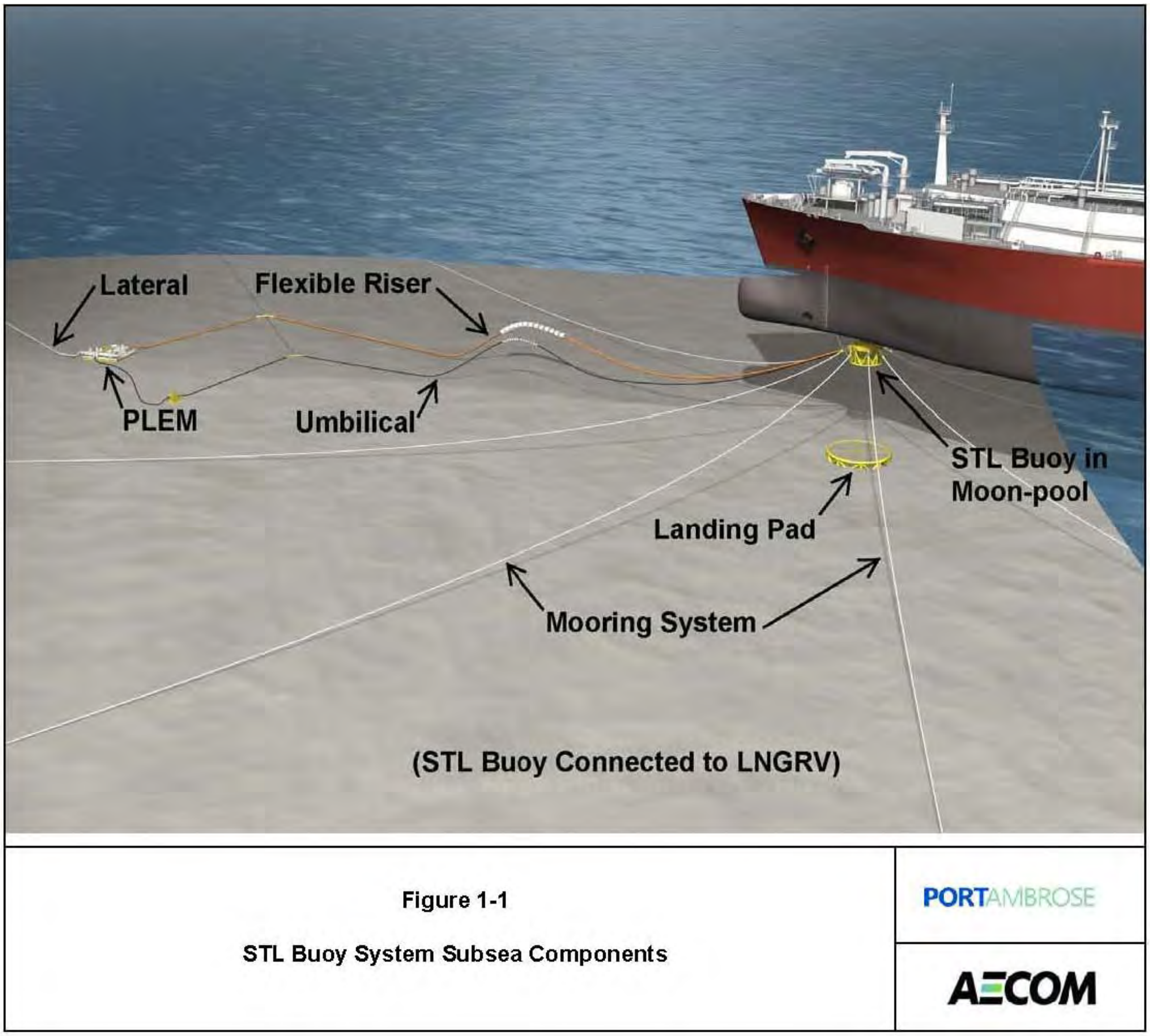


Figure 1-1 STL Buoy System

1.3 Construction phase

Construction of the Project, which will involve the fabrication and installation of STL Buoy systems 1 and 2, the accompanying Laterals, the Mainline, and two tie-in assemblies, is scheduled to be completed during a 20 month period spread over two calendar years. Off-site fabrication of components and related pre-construction activities are scheduled to commence in late 2015 and take approximately nine to twelve months to complete. Installation of offshore components is scheduled to begin in early 2016 and take approximately nine months to complete. Installation activities will be completed during late fourth quarter 2016, with the proposed Project scheduled to begin delivery of natural gas by the end of 2016.

1.4 Operational phase

The natural gas will be transported in a liquid state to Port Ambrose aboard LNGRVs. LNGRVs will approach the Port from the south using the Hudson Canyon to Ambrose traffic lane and depart using the Ambrose to Nantucket traffic lane.

During operation, the LNGRVs will regasify LNG and deliver natural gas to the Port. Upon arrival at the Port, each LNGRV will retrieve and connect to one of the two submerged STL Buoys. Once connected to a STL Buoy, the LNGRV will begin to vaporize the LNG using the on-board closed-loop shell and tube regasification system, and deliver natural gas at pipeline pressures through the STL Buoy system and Laterals to the Mainline.

The STL Buoys hold the LNGRVs on location throughout the unloading cycle by means of mooring lines secured to anchor points located on the seabed. The unloading duration is expected to be 5 to 16 days. Port Ambrose is designed for a two-buoy system where if required one LNGRV is moored and unloaded while another LNGRV is in transit or in the process of mooring or unmooring at the other STL Buoy. Upon completion of unloading, an LNGRV disconnects from the STL Buoy and departs to reload. This capability of overlapping sequence provides operational flexibility and can ensure uninterrupted, continuous flow of natural gas to the subsea pipeline system through the STL Buoys.

The Port will receive up to 45 LNGRVs per year. At nominal rate, the proposed Port facilities are designed to deliver an annual average of approximately 400 MMscf/d of natural gas at pipeline pressure. The maximum peak send-out for one STL Buoy is 650 MMscf/d. The maximum peak send-out for two STL Buoys is 660 MMscf/d.

1.5 Decommissioning phase

Upon the end of the useful life of the Project, Port Ambrose will be decommissioned. The Mainline and Laterals will be abandoned in place in accordance with 30 CFR 250, Subpart J and Q and 49 CFR Part 192. The Mainline will be abandoned in place and disconnected from all supply sources and gas delivery locations, depressurized, purged, filled with seawater, cut, and plugged with the ends buried. The hot-tap connection to the Transco Lower New York Bay Lateral will be sealed or capped to allow for continued operation of the Transco pipeline. The Laterals will be disconnected from the PLEM and the ends sealed or capped.

STL Buoys, PLEMs, flexible risers, and control umbilicals will be recovered from the site and demobilized to a central storage location onshore. The mooring chains and wire rope connecting the anchors to each STL Buoy will be recovered and demobilized to a central storage location onshore. The mooring piles will be inspected and recovered from the seafloor by reversing the installation process. A pump skid will be placed at the anchor pump nozzle utilizing remotely operated vehicles (ROVs) or a self-contained system that is operated from the surface via an umbilical. With pressure applied inside the anchor compartment the anchor will rise above the seabed, whereupon it will be lifted by a crane operating off of a heavy lift vessel and demobilized to shore. Alternatively, all portions protruding above the normal sea bed will be cut below the mud line, with the cut-off section recovered to the work barge/vessel and demobilized to shore for disposal.

Data on the abandoned pipeline facilities will be submitted to the Department of Transportation, Pipeline and Hazardous Material Safety Administration's National Pipeline Mapping System in accordance with 49 CFR § 192.727(g)(1).

1.6 Routine maintenance

During operation of the Port, it is anticipated that planned maintenance activities will occur on a routine basis. Routine maintenance activities are typically short in duration (several days or less) and require small vessels (less than 300 gross tons) to perform. Such activities include attaching/detaching and/or cleaning the buoy pick up line to the STL buoy, performing surveys and inspections with a ROV, and cleaning or replacing parts (e.g. bulbs, batteries, etc.) on the floating navigation (i.e., marker) buoys. Every seven to 10 years, an intelligent pig will be run down the Mainline and Laterals to assess the integrity of the pipeline system. This particular activity will require several large construction-type vessels and several weeks to complete.

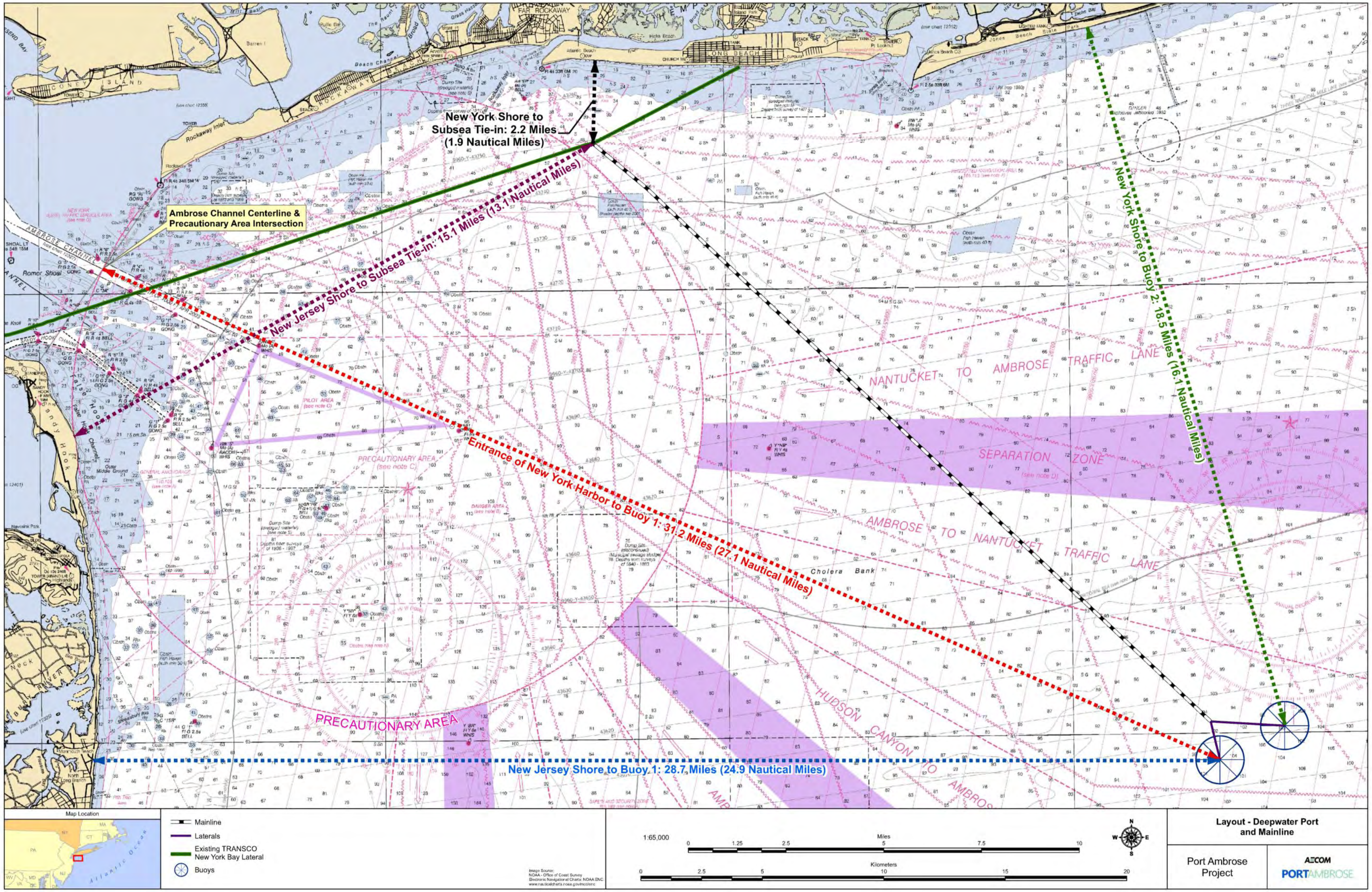
1.7 Unplanned events (non-routine repairs and unplanned incidents)

It is anticipated that repair activities will occur on a less frequent basis. While it is not possible to predict actual repair events, and dates and duration of these events, it is likely that some repairs will occur over the life of the Project. A description of these possible events is presented below.

Unplanned events can be either relatively minor, or in some cases, major requiring several large, construction-type vessels and an extensive mitigation program similar to that employed during the construction phase of the Project. Minor repairs are typically shorter in duration and could include fixing flanges or valves, replacing faulty pressure transducers, or repairing a stuck valve. These kinds of repairs would require one diver support vessel and could take from a few days to several weeks depending on the nature of the problem.

Major repairs and unplanned incidents, on the other hand, would be longer in duration and typically require large construction vessels similar to those used to install the pipeline and set the buoy and anchoring system. These vessels would typically mobilize from local ports, Canada, or the Gulf of Mexico. Major repairs would typically require upfront planning, equipment procurement, mobilization of vessels and possibly saturation divers. Examples of major repairs, although unlikely to occur, are damage to the riser or umbilical line and their possible replacement, damage to the pipeline system and manifolds, or anchor chain replacement. These types of repairs could take two to four weeks or possibly longer.

Figure 1-2 Location map



2.0 Underwater Noise Overview

2.1 Nature of underwater sound

Sound is an acoustic pressure wave that travels through a medium, such as water or air, and occurs as an oscillatory motion of the water or air particles driven by a vibrating source. The magnitude of the water or air particle motion determines the intensity of the sound. The rate at which the water or air particles oscillate determines its frequency, given in cycles per second or Hertz (Hz).

Sound travels about four-and-a-half times faster in water than in air. The absorption of sound at frequencies where man-made noise generally has the most energy is much smaller in water than in air. As a result, noise is typically audible over much greater ranges underwater than in air. Most sources of noise, including movement of large shipping vessels generate acoustic energy over a broad range of frequencies. Screeching or whistling noises are composed mainly of high frequency sounds while rumbles or booms are composed mainly of low frequency sounds.

Sounds are usually characterized according to whether they are continuous or impulsive in character. Continuous sounds occur without pauses and examples include shipping noise and dredging. Impulsive sounds are of short duration and can occur singularly, irregularly, or as part of a repeating pattern. Blasting represents a single impulsive event whereas the periodic impacts from a pile driving rig results in a patterned impulsive sequence. Impulsive signals typically sound like bangs and generally include a broad range of frequencies.

Sound pressures are measured with a hydrophone when underwater and a microphone when in air. The international standard unit of sound pressure is the Pascal (Pa). Sound pressures encountered underwater and in air range from levels just detectable by the mammal ear (hundreds of micro Pascals (µPa)) to much greater levels causing hearing damage (billions of Pa). Because this range is so enormous, sound pressure is normally described in terms of a sound pressure level (SPL) with units of decibel (dB) referenced to a standard pressure of 1 µPa for underwater and 20 µPa for airborne acoustics.

2.2 Underwater noise metrics

Underwater noise metrics commonly used for presenting source, measured or received underwater noise levels include the following:

- *Sound pressure level* (SPL) – Sound pressure is expressed in units of dB re 1 µPa, and in underwater noise is often averaged over a measurement period or provided as a peak level.
  - Continuous sources such as shipping noise and dredging are commonly characterized in terms of a root mean square SPL (denoted dB_{rms}) averaged over the measurement period.
  - Impulsive sources are often characterized in terms of the peak level (denoted dBpeak), which is the highest sound pressure over the measurement period.
- *Sound exposure level* (SEL) – Sound energy over the measurement period expressed as an equivalent sound level for a 1-second exposure period, expressed in units of dB re 1 µPa2s. The SEL is commonly used for impulsive sources because it allows a comparison of the energy contained in impulsive signals of different duration and peak levels. The measurement period for impulsive signals is usually defined as the time period containing 90% of the sound energy.
- *Source level* –The source level is defined as the sound pressure (or energy) level that would be measured at 1 m from an ideal point source radiating the same amount of sound as the actual

source being measured. The intensity of underwater noise sources is compared using the source level (SL) expressed in units of dB re 1 µPa at 1 m.

SPLs and SELs can be presented either as overall levels or as frequency dependent spectral or third-octave band levels indicating the frequency content of a source. Overall SPLs and SELs present the total average noise and energy level, respectively, within a given frequency bandwidth – usually the band that contains most of the energy. Spectral density levels are expressed in units of dB re 1 µPa2/Hz and provide a greater frequency resolution than third-octave band levels, which are expressed in units of dB re 1 µPa.

2.3 SEL accumulation time

SEL is a noise descriptor typically used to provide a comparative measure of sound levels from sources of different durations. SEL achieves this by converting noise levels occurring over varying exposure periods to equivalent sound levels with a standard reference time, which is typically one second. It can be thought of as incorporating all the acoustic energy emitted by a source over a time period into an equivalent noise level for a one second period.

Underwater noise sources have significant variation in their duration. For example, impact piling typically consists of short pulses of noise from hammer impacts which occur for 1-2 hours, whereas noise from vessel movements is typically a steady noise level occurring for the duration of transit. SEL is a descriptor which allows for comparison of the noise levels from these different sources.

Noise from an impact piling source can be considered on a per-impact time period (approximately 0.1 seconds for 90% of the impact sound energy) or as a cumulative exposure to noise from multiple impacts over the course of pile installation. SEL can therefore be presented as a SEL per-impact level or as a cumulative level for a chosen accumulation time.

We have distinguished cumulative SEL levels in this report by using the subscript ‘c’ (SEL_c). We note that JASCO uses the terminology cSEL in their reporting to represent the same metric.

2.4 Project specific sources of underwater noise

Underwater noise generation is likely to occur during construction and operations phases (including normal operations and routine maintenance), decommissioning and during unplanned events (e.g., unplanned repairs or incidents).

On-site construction is to be undertaken between May and October 2016 during favorable weather conditions. During the construction phase, each STL buoy’s permanent mooring system will require the installation of eight suction piles (anchors). While suction piles are the preferred and planned anchoring system, impact piles would be only be used if absolutely necessary, based on deep geotechnical boring data and design considerations.

Because impact piling was assessed to have the highest potential for sound generation associated with the proposed Project, a technical feasibility study was conducted to determine if suction pilling was a possible alternative to impact piling (Moffatt and Nichol 2014). According to the Design and Installation Concept Verification study by Moffatt and Nichol (2014), it is expected that the anchors can be installed in the sandy ground conditions and water depths anticipated at the Port Ambrose deepwater port site using suction piles. Although underwater sound measurements of suction pile installations are not available, it is expected that the noise from this method of anchor placement would be negligible because the only noise source is the suction pump (Spence et al. 2007). All impulsive type sounds are removed using this approach (CSA Ocean Sciences Inc. 2014).

If suction piles cannot be used during the construction phase of the Project, impact piling may be considered. If the unlikely alternative method of impact piling is necessary, noise from impact piling will be considerably louder than the ambient underwater noise environment in the vicinity of the piling, and will dominate any other underwater noise from simultaneous construction activities. In the unlikely event that impact piling is used for the Project, the proposed duration of pile driving has been estimated to be approximately 2.5 hours per pile, or 40 hours total for the 16 piles.

Construction of the Mainline to connect with the Lower New York Bay Lateral will potentially create underwater noise during pipeline installation, interconnection and lowering/backfilling. Pipeline construction will utilize a pipe lay vessel, plow vessel, and a dive support vessel. A jet plow is proposed for an approximate 3-mile Mainline section just north of the Nantucket to Ambrose traffic lane.

Port Ambrose will be operational all year long; however LNG, RV and regasification activities will predominantly occur during winter during the peak of the heating season. Underwater noise is anticipated to be produced by the LNGRVs during the approach, mooring, maneuvering on the buoy and regasification procedures. A standby Support Vessel will also be located in close proximity to the LNGRVs during mooring and regasification. The highest-energy source of underwater sound during the operation phase will be from vessel transits near the Port and from mooring activities. The Project is to be constructed approximately 30 miles offshore of the Port of New York and New Jersey, which is considered the third busiest port in the United States. Vessel sounds during operations will result from propeller cavitation and propulsion, in addition to flow noise from water dragging across the hull and bubbles breaking in the wake. The dominant sound source from vessels is propeller cavitation with noise intensity dependent upon size and speed of the vessel (BOEMRE 2009). Noise impacts from LNGRVs are expected to be comparable to those generated by common and existing vessel traffic in the New York Bight. Underwater sound generated from routine maintenance, decommissioning and unplanned events will be similar to those from the construction and operations phase of the Project and as such were not modeled by JASCO as unique sound sources (2014). Because these activities utilize similar equipment (e.g. support vessels) with similar sound sources for a shorter duration, they are not discussed further.

2.5 Existing underwater noise environment

The level and frequency characteristics of the ambient noise environment are two factors that control how far away a given noise source can be detected (Richardson et al. 1995). In general, noise is only detectable if it is within the audible hearing range of the receiver, and of a higher level than the ambient noise environment at similar frequencies. A lower ambient noise environment results in audible noise out to greater ranges before diminishing below the background noise level. The potential zone in which noise emissions from a source are detectable depends on the levels and types of ambient noise in the waters surrounding the noise source.

The main sources of ambient noise in the ocean are man-made sources such as shipping and sonar activity, and environmental sources such as wind-dependent noise and biological noise. Other environmental sources include surf noise typically localized near the coast, precipitation noise from rain and hail, seismic noise from volcanic and tectonic activity, and thermal noise (Wenz 1962).

Between 500 Hz and 100 kHz, the ambient environment is typically dominated by wind and wave noise where the noise levels tend to increase with increasing wind speed. Ambient ocean noise due to wind and waves is often described in relation to sea state. Wenz (1962) determined an empirical rule as an approximation for spectrum levels of wind-dependent ambient noise. Between 500 Hz and 5 kHz, spectrum levels decrease 5 dB per octave with increasing frequency, and increase 5 dB with each doubling of wind speed from 5 to 75 km/h. The spectrum level at 1 kHz in shallow water is 56 dB re 1 μPa2/Hz when the wind speed is 9 km/h (Beaufort sea state two). In an open ocean environment, sea states of greater than four are common, resulting in wind-dependent ambient overall noise levels of 100–120 dB re 1 μPa.

The main sources of ambient underwater noise in the waters surrounding the Port and Laterals are likely to be shipping noise from the Port of New York and New Jersey, wind-dependent noise, precipitation noise and surf noise in the regions closer to shore. Of these sources, shipping noise is considered to be the dominant source, with the Port located approximately 2.5 km from the closest traffic lane (Ambrose to Nantucket Traffic Lane), and 50 km to the entrance of New York Harbor, as shown in Figure 1-1. The Port of New York and New Jersey is considered the third busiest Port in the U.S. by total vessel calls, with the most common vessel types being container ships, tankers, and roll on/roll off vessels (U.S. Department of Transportation Maritime Administration 2013). Surface shipping is the most widespread source of anthropogenic, low frequency (0 to 1,000 Hz) noise in the oceans (Simmonds and Hutchinson 1996). Source levels for commercial ships range from 180-195 dB re 1 μPa which dominate underwater noise in the 10-500 Hz frequency bands (NRC 2003, Hildebrand 2009, McKenna et al. 2012).

3.0 Law and Policy

3.1 ESA and MMPA

The most relevant laws that need to be considered when assessing the impacts of underwater sound on marine fauna are the ESA and MMPA. The ESA protects all endangered and threatened species from extinction, while marine mammals have the additional protection of the MMPA.

3.1.1 Endangered Species Act of 1973

The ESA's purpose is to prevent the extinction of imperiled flora and fauna by protecting both the species and its environment from harm. To qualify for protection, a species must be formally listed under the ESA. The ESA is administered by two federal agencies, the National Oceanic and Atmospheric Administration (NOAA) and the United States Fish and Wildlife Service (USFWS).

Under the ESA, "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Of these forms of take, harassment and harm are most relevant to underwater noise. The term "harm" is defined under the ESA as "any act which actually kills or injures fish or wildlife" [30 CFR Part 222, 1999 amendment]. USFWS defines ESA "harassment" as an action that creates the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to breeding, feeding or sheltering.

Section 9 of the ESA prohibits the incidental take of ESA-listed species. Section 7 of the ESA requires that all federal agencies consult with the USFWS or NOAA Fisheries, as applicable, before initiating any action that could affect a listed species. Through the Deepwater Port application review process, the permitting agency is required under the ESA to consult with USFWS or NOAA to evaluate the direct and indirect effects on federally listed threatened and endangered species and their critical habitat, using the best scientific and commercial data available. If it is concluded that the Project is likely to adversely affect listed species or their habitats, the authorizing agency must request consultation with the USFWS and/or NOAA Fisheries. After consultation, USFWS and/or NOAA Fisheries will prepare a biological opinion (BO) on whether the proposed activity will jeopardize the continued existence of a listed species. If the agencies' opinion is that the Project is likely to jeopardize the continued existence of a listed species or habitat, they may issue an incidental take statement, provided that reasonable and prudent measures are designed to minimize the impact of incidental take that might otherwise result from the proposed action.

3.1.2 Marine Mammal Protection Act of 1972

The MMPA protects all marine mammal species within the United States. The MMPA is administered by NOAA and the USFWS. Under the MMPA, the term "take" means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal.

The MMPA prohibits the take of marine mammals, with certain exceptions; including the issuance of incidental take authorizations (ITAs) and Letters of Authorization (LOAs), or Incidental Harassment Authorizations (IHAs) to incidentally take small numbers of marine mammals by "harassment." Sections 101(a)(5)(A) & (D) of the MMPA direct the Secretary of Commerce (or Secretary of Interior for some species) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made. Through delegation by the Secretary of Commerce, NMFS may authorize the incidental taking of marine mammals if it finds that the total taking will have a negligible impact on the species or stock(s). NMFS must also set forth the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings.

Two levels of harassment (relative to take) are defined under the MMPA: Level A Harassment ("harm") and Level B Harassment ("harassment"). Level A Harassment is defined as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild. Level B Harassment is defined as any act of pursuit, torment, or annoyance which disturbs a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild.

3.2 Policy and guidance documents

3.2.1 NOAA draft guidance for assessing the effects of anthropogenic sound on marine mammals

NOAA released a draft document entitled *Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals* (Draft Guidance). The Draft Guidance was open for public comment up until 14 March 2014, and is anticipated to be finalized and released formally sometime this year. When finalized, the Draft Guidance is intended to be used as a tool to assess impacts of anthropogenic sound on marine fauna under the jurisdiction of the NMFS. It provides objective noise levels for which individual marine mammals are predicted to experience change in their hearing sensitivity, and is intended to be used by NOAA and other relevant stakeholders when seeking to determine the impact of activities on marine mammals from underwater noise generation.

In the Draft Guidance, NOAA equates the onset of Permanent Threshold Shift (PTS) with "harm" as defined in the ESA, and with "Level A Harassment" as defined in the MMPA. As such, PTS is considered equivalent to these two types of takes. NOAA equates Temporary Threshold Shift (TTS) as "harassment" as defined under the ESA and "Level B Harassment" as defined in the MMPA. It is worth noting that NOAA also considers behavioral changes to constitute "harassment" and "Level B Harassment"; however, objective criteria for assessing behavioral change in marine mammals have not yet been finalized.

3.2.2 California Department of Transportation Fisheries Hydro-acoustic Working Group interim criteria

Research studies and/or acoustic guidance or regulations related to fish and underwater sound is lacking. The California Department of Transportation established a Fisheries Hydro-acoustic Working Group (FHWG) to develop interim noise exposure criteria for injury to fish from pile driving. The FHWG consists of key technical and policy staff from the U.S. Federal Highway Administration (FHWA), NOAA Fisheries, Fish and Wildlife Service (USFWS), various Departments of Transportation, and national experts on the effects of underwater noise on fish.

The FHWG has produced a number of publications (Hastings and Popper 2005, Popper et al. 2006, Carlson et al. 2007, Buehler et al. 2007) culminating in an Agreement in Principle by the signatory agencies to interim criteria for injury to fish from pile driving activities (FHWG 2008). The interim criteria address three major effects including non-auditory tissue damage, auditory tissue damage and TTS. Because of the lack of federal guidance on this issue and unlikely use of pile driving for the Project we are utilizing the FHWG criteria to discuss potential impacts of underwater sound on endangered fish species in the Project area as a general reference to sound sources.

4.0 Key Biological Resources

This section outlines the species that have been identified as likely to occur in the proposed Project area and are listed under the ESA as threatened or endangered, or protected under the MMPA. Details of species abundance were provided in the Deepwater Port License Application Environmental Evaluation Topic Report 4 –Biological Resources. NOAA also provided information on listed species' of concern in their letter to Liberty dated 12 August 2013, included in this document as Appendix A.

4.1 Marine mammals

In the western North Atlantic Ocean, 31 species of marine mammals have been observed. Table 4-1 lists these species along with their listing status (ESA and MMPA status), and expected occurrence in the vicinity of the Project (both Port and Mainline). Of the 31 species of marine mammals observed in the western North Atlantic Ocean only nine species (three whales, two dolphins, one porpoise, and three seals) are thought to occur in the Project area; with the three whales listed as endangered under the ESA.

Twenty-six of these 31 mammal species occurring in the western North Atlantic Ocean belong to the Order Cetacea. Of these cetaceans, six belong to the suborder Mysticeti (baleen whales), and the remaining 20 belong to the suborder Odontoceti (toothed whales and dolphins). There are six whale species listed under the ESA as endangered that transit the NY Bight area, including the following species: fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musculus*), humpback whale (*Megaptera novaeangliae*), North Atlantic right whale (*Eubalaena glacialis*), Sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*). In addition to these listed species, several dolphin species protected under the MMPA have been sighted in the vicinity of the NY Bight (USFWS 1997), or have stranded along the New York Coastline (NOAA/NMFS 2001).

The NY Bight area is also important wintering habitat for four species of seals, all of which are protected under the MMPA, including: harbor seals, gray seals, harp seals, and hooded seals (USFWS 1997). Harbor seals (*Phoca vitulina*) are the most common seals along the U.S. east coast (NOAA/NMFS 2008c) and the New York Bight is a significant wintering area for harbor seals, including several haul-out locations along the beaches of Long Island (NYSDEC 2012d, CRESLI 2012b).

Species known to occur in the Western North Atlantic Region are presented in Table 4-1. Because many of the species listed only transit the area, occur in deeper water, or occur rarely, it is expected that many of them will not occur in the Project area (Port or Mainline). Section 4.1.1 provides a detailed description of the six ESA listed marine mammals that could transit the NY Bight area during construction or operations of the Port. Only three of these (fin whale, humpback whale, and North Atlantic right whale) are expected to occur in the Project area (Port or Mainline) (NOAA 2013). The other three ESA-listed species of Mysticete whales and one endangered species from the Order Sirenia, the West Indian manatee, are not expected in the Project (Port or Mainline) area.

According to a letter dated August 12, 2013 by NOAA, provided in Appendix A, the federally listed cetacean species possibly occurring in the Project area are the North Atlantic right whale, humpback whale and fin whale. These species are seasonally present in waters off New York and New Jersey, using the area as a migration route. The North Atlantic right whale occurs in waters from November through April (with the exception of transient whales during other times), while Humpback and Fin whales more commonly transit the area from September through May (see additional details below).

In addition to the description of endangered whales, this assessment also provides a short overview of the 24 additional species of marine mammals protected under the MMPA in Section 4.1.2 that are known to occur in the NY Bight area. Only six of these marine mammal species have the potential to transit the Project area (Port and Mainline):

- harbor porpoise (*Phocoena phocoena*),
- bottlenose dolphin (*Tursiops truncatus*),
- common dolphin (*Delphinus delphis*),
- harbor seal (*Phoca vitulina*),
- gray seal (*Halichoerus grypus*), and
- harp seal (*Pagophilus groenlandicus*).

Table 4-1 Marine mammals documented to occur in the north western Atlantic Ocean and their expected occurrence in the Project Area

Common Name	Scientific Name	Regulatory Status (ESA, MMPA)	N.Y. Bight Status	Expected Occurrence in Project Area
Order Cetacea				
Suborder Mysticeti (baleen whales)				
Blue whale	*Balaenoptera musculus*	ESA (Endangered), MMPA (Protected)	R, S	**Not expected to occur (highly unlikely).** Prefer deeper and more northern waters.
Fin whale	*Balaenoptera physalus*	ESA (Endangered), MMPA (Protected)	A, S	**Possible occurrence within the Port and Mainline area**, especially in winter/early spring or perhaps fall.
Humpback whale	*Megaptera novaeangliae*	ESA (Endangered), MMPA (Protected)	C, S	**Possible occurrence within the Port and Mainline area.** Prefer deeper water during migrations, but transients possible in shallower waters of N.Y. Bight in fall-spring.
North Atlantic right whale	*Eubalaena glacialis*	ESA (Endangered), MMPA (Protected)	R, S	**Possible (rare) occurrence in the Mainline area.** Observed in mid-Atlantic waters and New York Bight during northward spring migrations and possibly fall (November-April).
Sei whale	*Balaenoptera borealis*	ESA (Endangered), MMPA (Protected)	R, S	**Not expected to occur (highly unlikely).** Prefer deep waters of continental shelf edge and seaward.
Minke whale	*Balaenoptera acutorostrata*	MMPA (Protected)	A, S	**Not expected to occur (unlikely)**. Prefer deeper continental shelf waters.

Common Name	Scientific Name	Regulatory Status (ESA, MMPA)	N.Y. Bight Status	Expected Occurrence in Project Area
Suborder Odontoceti (toothed whales and dolphins)				
Sperm whale	*Physeter macrocephalus*	ESA (Endangered), Strategic	C, S	**Not expected to occur (unlikely).** Prefer deeper continental shelf waters.
Pygmy sperm whale	*Kogia breviceps*	MMPA (Protected)	C, UNK	**Not expected to occur (unlikely).** Prefer deeper waters seaward of continental shelf.
Dwarf sperm whale	*Kogia simus*	MMPA (Protected)	C, UNK	**Not expected to occur (unlikely).** Prefer deeper waters of continental shelf edge and slope.
Long-finned pilot whale	*Globicephala melas*	MMPA (Protected)	A, UNK	**Not expected to occur (unlikely).** Prefer deeper waters of the continental shelf edge and seaward.
Cuvier's beaked whale	*Ziphius cavirostris*	MMPA (Protected)	UNK	**Not expected to occur (unlikely).** Prefer deeper waters of the continental shelf edge.
Mesoplodon beaked whale	*Mesoplodon* spp.	MMPA (Protected)	UNK	**Not expected to occur (unlikely).** Prefer deeper waters of the continental shelf edge.
Killer whale (Orca)	*Orcinus orca*	MMPA (Protected)	R, UNK	**Not expected to occur (unlikely)** due to its rarity in this portion of the Atlantic.
Pygmy killer whale	*Feresa attenuata*	MMPA (Protected)	R, UNK	**Not expected to occur (unlikely)** due to its rarity in this portion of the Atlantic.
False killer whale	*Pseudorca crassidens*	MMPA (Protected)	UNK	**Not expected to occur (unlikely).** Prefers deeper waters (>1000 m).
Melon-headed whale	*Peponocephala electra*	MMPA (Protected)	UNK	**Not expected to occur (highly unlikely).** Prefers deeper and warmer waters.
Risso's dolphin	*Grampus griseus*	MMPA (Protected)	A, UNK	**Not expected to occur (unlikely).** Prefers deeper waters (>1000 m).
Bottlenose dolphin	*Tursiops truncatus*	MMPA (Protected)	A, S	**Possible occurrence within the Port and Mainline area** May through October.
Common dolphin	*Delphinus delphis*	MMPA (Protected)	A, UNK	**Possible occurrence within the Port and Mainline area,** especially in winter or spring.
Striped dolphin	*Stenella coeruleoalba*	MMPA (Protected)	A, S	**Not expected to occur (unlikely).** Prefer deeper continental shelf waters.

Common Name	Scientific Name	Regulatory Status (ESA, MMPA)	N.Y. Bight Status	Expected Occurrence in Project Area
Clymene dolphin	*Stenella clymene*	MMPA (Protected)	UNK	**Not expected to occur (highly unlikely).** Prefer deeper (>250 m) and warmer waters.
Atlantic spotted dolphin	*Stenella frontalis*	MMPA (Protected)	A, S	**Not expected to occur (unlikely).** Prefer deeper waters near the shelf edge.
Spinner dolphin	*Stenella longirostris*	MMPA (Protected)	UNK	**Not expected to occur (unlikely).** Prefer deeper waters (>2000 m).
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	MMPA (Protected)	A, Y	**Not expected to occur (unlikely)** due to low abundance.
White-beaked dolphin	*Lagenorhynchus albirostris*	MMPA (Protected)	UNK	**Not expected to occur (unlikely).** Prefer colder waters, further north.
Harbor porpoise	*Phocoena phocoena*	MMPA (Protected)	I, S	**Possible occurrence within the Mainline and Port Area,** in the spring and summer months.
Order/Suborder/Superfamily Carnivora/Caniformia/Pinnipedia (pinnipeds)				
Harbor seal	*Phoca vitulina*	MMPA (Protected)	A, ES	**Possible occurrence in the Project area.** New York Bight is a significant wintering area for species so could transit the Project area from Sept. - May.
Gray seal	*Halichoerus grypus*	MMPA (Protected)	I, ES	**Possible occurrence in the Project area.** Prefers more northern waters, but could transit the Project area from Sept. - May.
Harp seal	*Pagophilus groenlandicus*	MMPA (Protected)	I, S	**Possible occurrence in the Project area.** Prefers more northern waters, but could transit the Project area from Sept. - May.
Hooded seal	*Cystophora cristata*	MMPA (Protected)	R, S	**Not expected to occur (unlikely).** Prefers deeper waters, but rare transients possible.

Common Name	Scientific Name	Regulatory Status (ESA, MMPA)	N.Y. Bight Status	Expected Occurrence in Project Area
Order/Family Sirenia/Trichechidae (Sirenians)				
West Indian Manatee	*Trichechus manatus*	ESA (Endangered), MMPA (Protected)	R, S	**Not expected to occur (highly unlikely).** Prefers warmer waters, but very rare transients possible.
Sources: ACS (2008) NOAA/NMFS (2008a) NOAA/NMFS (2008b) Read et al. (2008) USFWS (2011) Waring et al. (2013) Neubert and Sullivan (2014) **Key:** A=Abundant, C=Common, I=Increasing in presence, R=Rare, UNK=Unknown, Y= Year-round, S=Seasonal, ES=Extended seasonal				

4.1.1 Marine mammals listed as endangered that occur in the northwestern Atlantic Ocean

4.1.1.1 Blue whale (*Balaenoptera musculus*) – Endangered

At least three subspecies of blue whales have been identified based on body size and geographic distribution of which *B. musculus musculus* occurs in the Northern Hemisphere. In the western North Atlantic Ocean, blue whales are found from the Arctic to at least the mid-latitude waters of the North Atlantic (CeTAP 1982, Wenzel et al.1988, Yochem and Leatherwood 1985, Gagnon and Clark 1993).

The size of the blue whale population in the North Atlantic is uncertain. The population has been estimated to be from a few hundred individuals (Allen 1970, Mitchell 1974) to 1,000 to 2,000 individuals (Sigurjónsson 1995). Sears et al. (1987) identified over 300 individual blue whales in the Gulf of St. Lawrence, which provides a minimum estimate for their population in the North Atlantic, and some speculate that there may be between 400 and 600 blue whales in the western North Atlantic (Mitchell 1974, Waring et al. 2011).

Direct studies of whale hearing have not been conducted for most species of large whales, but it is assumed that they can hear at the same frequencies that they vocalize (10-100Hz for blue whales) and are likely to be most sensitive at that range (Ketten 1997). A more recent study of blue whales observed responses to mid-frequency sonar signals in the 1-8 kHz range (Melcón et al. 2012).

The two main anthropogenic threats to blue whales are whaling and shipping. Historically, whaling represented the greatest threat to every population of blue whales and was ultimately responsible for listing blue whales as an endangered species. In the Eastern North Pacific, ship strikes were implicated in the deaths of five blue whales, from 2004- 2008 (Caretta et al. 2011). No confirmed ship strikes of blue whales were recorded in the North Atlantic or Gulf of Mexico between 2006 and 2010 (Henry et al. 2012).

Blue whales are <u>not likely (highly unlikely) to occur</u> in the Project area.

4.1.1.2 Fin whale (*Balaenoptera physalus*) – Endangered

Fin whales have two recognized subspecies: *Balaenoptera physalus physalus* (Linnaeus 1758) which occurs in the North Atlantic Ocean; and *B. p. quoyi* (Fischer 1829) which occurs in the Southern Ocean. Globally, fin whales are sub-divided into three major groups: Atlantic, Pacific, and Antarctic. Fin whales are widely distributed and occur in every ocean except the Arctic Ocean. In the North Atlantic Ocean, fin whales occur in summer foraging areas from the coast of North America to Greenland, Iceland, northern Norway and the Barents Sea to the Arctic. In winter, they can be found from the edge of sea ice in the North to as far south as the Gulf of Mexico and the West Indies in the Western Atlantic Ocean.

Fin whales are common off the Atlantic coast of the United States in waters immediately off the coast to the continental shelf. During the summer months, fin whales tend to congregate in feeding areas between 41°20'N and 51°00'N, from shore seaward to the 1,000 fathom contour (NOAA 2013). They are less concentrated in the nearshore environment than Humpback or North Atlantic right whales. In the Atlantic Ocean, fin whale migration in the fall occurs from the Labrador and Newfoundland region, south past Bermuda, and into the West Indies (Clark et al. 2002). The overall distribution of fin whales may be, at least in part, based on prey availability, as this species feeds by filtering large volumes of water for both invertebrates and fish (Watkins et al. 1984). Abundance estimates for the Western North Atlantic stock is 2,269 (CV = 0.37) (NMFS 2010), with a minimum population estimate of 1,678 (Waring et al. 2009).

Fin whales produce a variety of low-frequency sounds in the 10-200 Hz band (Watkins 1981, Watkins et al. 1987, Edds 1988, Thompson et al. 1992). As with other vocalizations produced by baleen whales, the function of fin whale vocalizations is unknown, although there are numerous hypotheses about the reasons for vocalizations. Some hypotheses for these vocalizations include: maintaining distance, species and individual recognition, information transmission, maintenance of social organization, location of topographic features, and location of prey resources (Thompson et al. 1992, NOAA 2013).

The three greatest anthropogenic stressors to fin whales are whaling, commercial fishing, and vessel strikes. It is thought that fin whales are killed and injured in collisions with vessels more frequently than any other whale in U.S. waters (NOAA 2013). Of 92 fin whales that stranded along the Atlantic Coast of the U.S. between 1975 and 1996, 31 (33%) showed evidence of collisions with ships (Laist et al. 2001). Between 1999 and 2005, there were fifteen reports of fin whales being struck by vessels along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada (Cole et al. 2005, Nelson et al. 2007). Of these reports, thirteen were confirmed as ship strikes which were reported as having resulted in the death of eleven fin whales.

Because fin whales are common in waters immediately off the Atlantic coast to the continental shelf, fin whales transiting through the area <u>could occur</u> in the Project area (Port and Mainline) during migrations.

4.1.1.3 Humpback whale (*Megaptera novaeangliae*) – Endangered

Humpback whales occur in the Atlantic, Indian, Pacific, and Southern Oceans. They migrate seasonally between tropical or sub-tropical waters in winter months where they reproduce; and temperate or sub-Arctic waters where they feed in summer months. In their summer foraging areas and winter calving areas, humpback whales tend to occupy shallower, coastal waters; during their seasonal migrations, however, humpback whales disperse widely in deep, pelagic waters and tend to avoid shallower coastal waters (Winn and Reichley 1985).

In the Atlantic Ocean, humpback whales range from the mid-Atlantic bight, the Gulf of Maine, across the southern coast of Greenland and Iceland, and along the coast of Norway in the Barents Sea. These whales migrate to the western coast of Africa and the Caribbean Sea during the winter. In the Atlantic Ocean, humpback whales aggregate in four feeding areas in the summer months: (1) Gulf of Maine; (2) western Greenland; (3) Iceland; and (4) Norway (Katona and Beard 1990, Smith et al. 1999). The principal breeding range for these whales lies from the Antilles and northern Venezuela to Cuba (Winn et al. 1975, Balcomb and Nichols 1982, Whitehead and Moore 1982). Stevick et al. (2003) estimated the size of the North Atlantic humpback whale population to be between 5,930 and 12,580 individuals and current estimates suggest that the global population of humpback whales consists of tens of thousands of individuals (NOAA 2013).

Humpback whales produce at least three kinds of vocalization: (1) complex songs with components ranging from at least 20Hz to 4 kHz (Payne 1970, Winn et al. 1970, Richardson et al. 1995); (2) social sounds in breeding areas that extend from 50 Hz to more than 10 kHz (Tyack and Whitehead 1983, Richardson et al. 1995); and (3) vocalizations in foraging areas that are less frequent, but tend to be 20Hz to 2 kHz (Thompson et al. 1986, Richardson et al. 1995). Based on mathematical models it is thought that humpback whales are sensitive to sound in frequencies ranging from 0.7 kHz to 10 kHz, with a maximum sensitivity between 2 and 6 kHz (Helwig et al. 2000).

Historically, whaling represented the greatest threat to humpback whales and was ultimately responsible for listing the species as endangered. Humpback whales are also killed or injured during interactions with commercial fishing gear and by vessel strikes. Along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada, there were 101 confirmed entanglement events between 2006 and 2010 (Henry et al. 2012). Of these, 20 resulted in serious injury and 9 resulted in mortality of humpbacks. As of 2008, there were more than 143 recorded ship strikes involving humpback whales worldwide (Van Waerebeek and Leaper 2008), and many more might go undetected or unreported.

Humpback whales that transit the area <u>could occur</u> in the Project area (Port or Mainline) during migrations in the fall and spring.

4.1.1.4 North Atlantic right whale (*Eubalaena glacialis*) – Endangered

NOAA Fisheries recognizes two extant groups of right whales in the North Atlantic Ocean (*E. glacialis*): an eastern population and a western population. In the western Atlantic Ocean, North Atlantic right whales generally occur in northwest Atlantic waters west of the Gulf Stream and are most commonly associated with cooler waters (21°C). North Atlantic right whales are most abundant in Cape Cod Bay between February and April (Hamilton and Mayo 1990, Schevill et al. 1986, Watkins and Schevill 1982), in the Great South Channel in May and June (Kenney et al. 1986, Payne et al. 1990) and off Georgia and Florida from mid-November through March (Slay et al. 1996). North Atlantic right whales use mid-Atlantic waters as a migratory pathway between the winter calving grounds and their spring and summer nursery feeding areas in the Gulf of Maine.

Kraus et al. (2005) estimated that about 350 individual right whales, including about 70 mature females, occur in the western North Atlantic. The western North Atlantic population numbered at least 361 individuals in 2005 and at least 396 in 2007 (Waring et al. 2012).

North Atlantic right whales produce a variety of sounds, including moans, screams, gunshots, blows, upcalls, downcalls and warbles that are often linked to specific behaviors (Matthews et al. 2001, Laurinolli et al. 2003, Vanderlaan et al. 2003, Parks et al. 2005, Parks and Tyack 2005). Sounds can be divided into three main categories: (1) blow sounds; (2) broadband impulsive sounds; and (3) tonal call types (Parks and Clark 2007). Most of these sounds range in frequency from 0.02 to 15 kHz. Recent analyses of North Atlantic right whale inner ears estimates a hearing range of approximately 0.01 to 22 kHz based on established marine mammal models (Parks et al. 2004, Parks and Tyack 2005, Parks et al. 2007).

Several human activities are known to threaten North Atlantic right whales, including: whaling, commercial fishing and shipping. Historically, whaling represented the greatest threat to North Atlantic right whales, reducing the North Atlantic right whale population to about 396 in the western North Atlantic Ocean. Whaling was ultimately responsible for their listing as an endangered species. Of the current threats to North Atlantic right whales, entanglement in commercial fishing gear and ship strikes currently pose the greatest threat to North Atlantic right whales. Along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada, there were 33 confirmed reports of right whales being entangled in fishing gear between 2006 and 2010 (Henry et al. 2012). Of these, right whales were injured in five of the entanglements and killed in four entanglements. In the same region, there were 13 confirmed reports of right whales being struck by vessels between 2006 and 2010 (Henry et al. 2012). Right whales were injured in one of the ship strikes and killed in five ship strikes during this same period.

Critical habitat has been designated for the North Atlantic right whale in Cape Cod Bay and the Great South Channel off Massachusetts, and off Georgia and Florida (50 CFR 226.203). In addition, a Mid-Atlantic U.S. Seasonal Management Area (SMA) has been set up within a 20 nm (37 km) radius of the Port of New York and New Jersey (40º29'42.2"N 073º55'57.6"W) from November 1 through April 30 to comply with NOAA's Ship Strike Reduction Rule (50 CFR 224.105). In this designated "Migratory Route and Calving Ground" area, vessels greater than or equal to 65 ft (19.8 m) in overall length must reduce speeds to 10 knots or less in order to avoid vessel strikes to North Atlantic right whales.

North Atlantic right whales transiting the area <u>could occur</u> (rarely) in the Project area (Mainline) and restrictions are in place to protect them (see SMA in Figure 4-1).

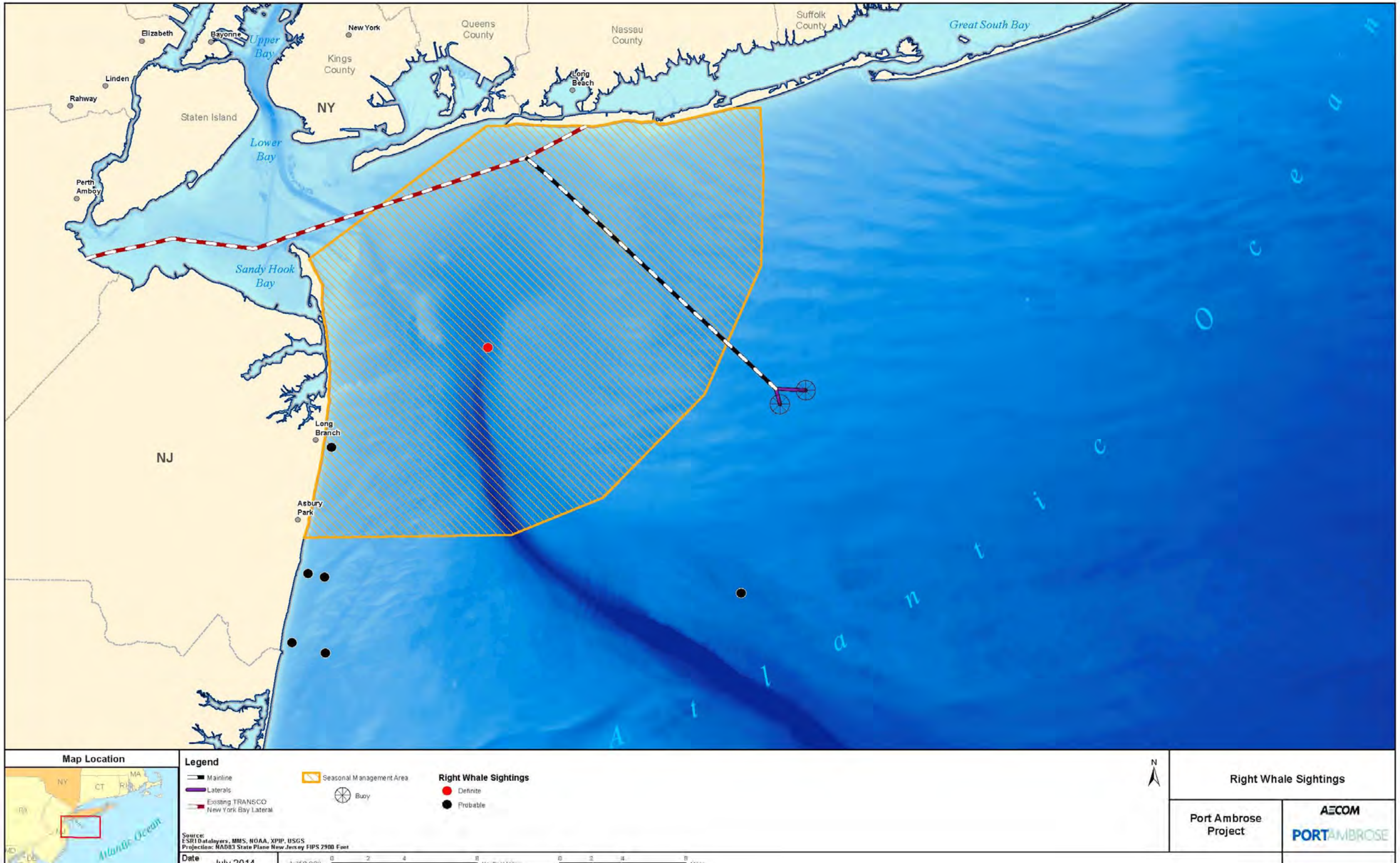
4.1.1.5 Sei whale (*Balaenoptera borealis*) – Endangered

Sei whales occur in every ocean except the Arctic Ocean. The migratory pattern of this species is thought to encompass long distances from high-latitude feeding areas in summer to low-latitude breeding areas in winter; however, the location of winter areas remains largely unknown (Perry et al. 1999). Sei whales are often associated with deeper waters and areas along the continental shelf edge (Hain et al. 1985); however, this general offshore pattern of Sei whale distribution is disrupted during occasional incursions into more shallow and inshore waters (Waring et al. 2004). In the western Atlantic Ocean, Sei whales occur as far North as Labrador, Nova Scotia, in the summer months and migrate south to Florida and the northern Caribbean in winter months (Gambell 1985, Mead 1977).

The 2004 abundance estimate of 386 is considered the best available for the Nova Scotia stock of Sei whales (Waring et al. 2012). There have been no direct estimates of Sei whale abundance in the entire North Pacific based on sighting surveys, but two abundance estimates based on recent line transect surveys of California, Oregon, and Washington waters are 74 (CV=0.88) and 215 (CV=0.71) Sei whales, respectively (Forney 2007, Barlow 2010).

There is a limited amount of information on the vocal behavior of Sei whales and their hearing. McDonald et al. (2005) recorded Sei whale vocalizations off the Antarctic Peninsula that included broadband sounds in the 100- 600 Hz range. Vocalizations from the North Atlantic population consisted of paired sequences of 10-20 short sweeps between 1.5-3.5 kHz (Richardson et al. 1995).

Figure 4-1 Proposed Port Ambrose Project in relation to the North Atlantic right whale SMA and historical sightings



Historically, whaling represented the greatest threat to Sei whales and was ultimately responsible for listing them as an endangered species. Sei whales are occasionally killed in collisions with vessels. Of three Sei whales that stranded along the Atlantic Coast of the U.S. between 1975 and 1996, two showed evidence of collisions with ships (Laist et al. 2001). Between 1999 and 2010, there were six reports of Sei whales being struck by vessels along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada (Cole et al. 2005, Nelson et al. 2007, Henry et al. 2012). Five of these ship strikes were reported as having resulted in the death of the Sei whale. Sei whales are occasionally found entangled. Along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada, there were three confirmed reports of Sei whales being entangled in fishing gear between 2006 and 2010, of which one died (Henry et al. 2012).

Sei whales are <u>not expected (very unlikely)</u> to occur in the Project area, because although they could transit the Project area during migrations in the fall and spring, their presence is very unlikely this close to shore in this region.

4.1.1.6 Sperm whale (*Physeter macrocephalus*) – Endangered

Sperm whales occur in every ocean except the Arctic Ocean. The distribution of the sperm whale in the U.S. Exclusive Economic Zone (EZZ) occurs on the continental shelf edge, over the continental slope, and into mid-ocean regions (Waring et al. 1993, Waring et al. 2001). In the western Atlantic Ocean, sperm whales are concentrated east-northeast of Cape Hatteras in winter, shifting northward in the spring and are found throughout the Mid-Atlantic Bight. Distribution extends further north to areas north of Georges Bank and the Northeast Channel region in summer, and then south of New England in fall, back to the Mid-Atlantic Bight.

Sperm whales have a strong preference for the 3,280 feet (1,000 meters) depth contour and seaward (Reeves and Whitehead 1997). While deep water is their typical habitat, sperm whales have been observed near Long Island, New York, in water between 41-55 meters (135-180 ft) (Scott and Sadove 1997). When they are found closer to shore, they are usually associated with sharp increases in bottom depths where upwelling occurs and biological production is high (Clarke 1956).

Whitehead (2002) estimated that prior to whaling sperm whales numbered around 1,110,000 and that the current global abundance of sperm whales is around 360,000 (coefficient of variation = 0.36) whales. Waring et al. (2007) concluded that the best estimate of the number of sperm whales along the Atlantic coast of the U.S. was 4,804 in 2004, with a minimum estimate of 3,539 sperm whales in the western North Atlantic Ocean.

Sperm whales produce loud broad-band clicks from about 0.1 to 20 kHz (Weilgart and Whitehead 1993, 1997, Goold and Jones 1995). Data from neonatal sperm whales respond to sounds from 2.5-60 kHz. Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins and Schevill 1975, Watkins et al. 1985).

Three human activities are known to threaten sperm whales: whaling, entanglement in fishing gear, and shipping. Historically, whaling represented the greatest threat to every population of sperm whales and was ultimately responsible for listing sperm whales as an endangered species. Several sperm whale entanglements have been documented in the North Atlantic and three sperm whales have been documented to have been killed by ship strikes (NOAA 2013).

Sperm whales are <u>not expected (unlikely) to occur</u> in the Project area due to their preference for deeper water. Though evidence suggests transients in the area are possible during migrations in the fall and spring, it is unlikely due to their rare occurrence close to shore.

4.1.2 West Indian manatee (*Trichechus manatus*) – Endangered

The West Indian manatee (*Trichechus manatus*) is listed as an endangered species by the USFWS. It is found in freshwater, brackish and marine habitats when they shelter in and/or near warm-water springs, heated industrial effluents, and other warm water sites, usually along the coast (Lefebvre et al. 2001). In the U.S. the distribution is mainly limited to peninsular Florida during the winter, but manatees expand their range and can disperse great distances during the summer months and have been seen as far north as Massachusetts and as far west as Texas (Rathbun et al. 1990, USFWS 2001).

Because of their preference for warmer waters and rare occurrence in the N.Y. Bight and surrounding area, the species is <u>not expected (highly unlikely) to occur</u> in or around the Project area.

4.1.3 Marine mammals protected under the MMPA documented in the northwestern Atlantic Ocean

Twenty-four non-listed (neither listed as threatened or endangered under the ESA) mammal species protected by the MMPA are considered likely to be present in the western North Atlantic Ocean and region for all or part of the year. Some of these species are mainly found either north or south of the Project area, but could be transient through the Project area. These species are as follows:

4.1.3.1 Minke whale (*Balaenoptera acutorostrata*)

The minke whale is a baleen whale with a worldwide distribution. Minke whales are more likely than other baleen whales to approach close to shore and can be found in bays and estuaries. Minke whales are highly migratory and move to cold temperate and polar waters in spring, returning to warmer waters in autumn. They are widely distributed within the U.S. Atlantic EEZ, although primarily north of the Project area, off the coast of New England (Waring et al. 2007). They feed opportunistically on crustaceans (e.g., krill), plankton (e.g., copepods), and small schooling fish (e.g., anchovies, dogfish, capelin, coal fish, cod, eels, herring, mackerel, salmon, sandlance, saury, and wolffish) (NOAA/NMFS 2012b).The best estimate for the Canadian east coast stock is 20,741 (Waring et al. 2013).

The minke whale is <u>not expected (unlikely) to occur</u> in the Project area due to its preference for continental shelf waters and waters further north. If an individual did transit the Project area it is more likely to occur in spring and fall than other months at this latitude.

4.1.3.2 Pygmy Sperm whale (*Kogia breviceps*)

Pygmy sperm whales may be found in all temperate, subtropical, and tropical waters seaward of the continental shelf edge and the slope (Waring et al. 2007, NOAA/NMFS 2008a). They are not believed to migrate. Primary food sources include octopus and squid, but the whales also eat crab, fish, and shrimp (ACS 2008). At sea, it is difficult to distinguish dwarf from pygmy sperm whales, so counts are often grouped together as “*Kogia* spp.” The best estimate for the current western North Atlantic population of pygmy sperm whale is 741 (Waring et al. 2013).

Pygmy sperm whales are <u>not expected (unlikely) to occur</u> in the Project area due to their preference for continental shelf edge and slope waters.

4.1.3.3 Dwarf sperm whale (*Kogia sima*)

Dwarf sperm whales are distributed worldwide in temperate to tropical waters along the continental shelf edge and slope (Waring et al. 2007, NOAA/NMFS 2008b).Their primary food sources are cephalopods (e.g., squid and octopus), crustaceans (e.g., shrimp and crabs), and fish (NOAA/NMFS 2008a). The best estimate for the current western North Atlantic population of dwarf sperm whale is 1,042 (Waring et al. 2013).

Dwarf sperm whales are <u>not expected (unlikely) to occur</u> in the Project area due to their preference for continental shelf edge and slope waters.

4.1.3.4 Long-finned pilot whale (*Globicephala melas*)

In the western Atlantic Ocean, the long-finned pilot whale is found from Canada to Cape Hatteras. These whales are found along the continental shelf edge and continental slope in deep pelagic waters off the Northeast United States coast in winter and early spring and migrate onto Georges Bank, into the Gulf of Maine, and into more northern waters in late spring. They tend to occupy areas of high relief or submerged banks (Waring et al. 2011). Most feeding occurs in deep waters (>656 feet [>200 m]) on prey such as fish (e.g., cod, dogfish, hake, herring, mackerel, and turbot), cephalopods (e.g., squid and octopus), and crustaceans (e.g., shrimp) (NOAA/NMFS 2008a). The long-finned pilot whale and the short-finned pilot whale are the only two species of pilot whales commonly found in the western Atlantic, and it is difficult to differentiate these two species at sea. There are an estimated 15,728 individuals from genus *Globicephala* in the area from Maryland to the Bay of Fundy (Waring et al. 2011). The best estimate for the current western North Atlantic population of long-finned pilot whale is 12,619 individuals (Waring et al. 2013).

Due to the long-finned pilot whales' preference for deeper water, this species is <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.5 Cuvier's beaked whale (*Ziphius cavirostris*)

The distribution of Cuvier's beaked whales is not well understood but appears, based on strandings records, to include the North Atlantic coast from Nova Scotia to Florida, as well as further south into the Caribbean. Most sightings of the species have occurred in the mid-Atlantic region along the continental shelf edge in late spring or summer (Waring et al. 2007). They prefer deeper pelagic waters (>0.5 mi [>1,000 m] deep), as well as steep underwater geologic features. They opportunistically feed on cephalopods (e.g., squid and octopus) and sometimes fish and crustaceans (NOAA/NMFS 2008a). The best estimate for the current western North Atlantic population of Cuvier's beaked whale is 4,962 individuals (Waring et al. 2013).

Due to their preference for deeper water, Cuvier's beaked whales are <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.6 Mesoplodon beaked whale complex (*Mesoplodon* spp.)

There are four species of beaked whales within the genus Mesoplodon that reside in the northwest Atlantic. They include True's beaked whale (*Mesoplodon mirus*), Gervais' beaked whale (*M. europaeus*), Blainville's beaked whale (*M.densirostris*), and Sowerby's beaked whale (*M. bidens*). These species are difficult to differentiate during field observations; so much of what is known about their distribution is at the genus level (Waring et al. 2007). They feed in deep waters on cephalopods (e.g., squid), mysid shrimp, and small fish (NOAA/NMFS 2008a). Most sightings of the genus have occurred along the continental shelf edge and in deeper waters. Of the Mesoplodon whales, Gervais' whales are the most commonly stranded. Sowerby's whales have the most northern distribution range, from New England north to the ice pack. The best estimate for the current western North Atlantic population of True's and Blainville's beaked whales is unknown, Gervais' beaked whale is 1,847 individuals, and Sowerby's beaked whale is 3,653 individuals (Waring et al. 2013).

Due to their preference for deeper water, species of the genus Mesoplodon are <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.7 Killer whale (*Orcinus orca*)

While present in all oceans of the world, killer whales are rare in U.S. waters, and very little is known about their distribution there. Rather than engaging in regular seasonal migration, they seem to follow food sources. They prefer colder waters and are one of the few species of whales that move freely from hemisphere to hemisphere. They are opportunistic feeders that prey on other marine mammals (sea lions, seals, porpoises, whales), sharks, penguins, squid, and fish (NOAA/NMFS 2008a). The current western North Atlantic population estimate for the killer whale is unknown (Waring et al. 2013).

Killer whales are <u>not expected (highly unlikely) to occur</u> in the Project area.

4.1.3.8 Pygmy killer whale (*Feresa attenuate*)

Pygmy killer whales are small members of the dolphin family found in deep tropical and subtropical areas around the world. They are present in the Northwest Atlantic, and individuals there are designated as a separate stock; however, only one sighting has been made in the Northwest Atlantic, and population estimates are not available (NOAA/NMFS 2008a; Waring et al. 2007, Waring et al. 2013).

Due to its rarity in the western North Atlantic, this species is <u>not expected (highly unlikely) to occur</u> in the Project area.

4.1.3.9 False killer whale (*Pseudorca crassidens*)

False killer whales, large members of the dolphin family, prefer deep (>0.5 mi [>1,000 m]), tropical to temperate waters. Along the eastern seaboard of the United States, they are found from the mid-Atlantic southward; however, population estimates for this area are not available (NOAA/NMFS 2008a, Waring et al. 2007, Waring et al. 2013). They feed on fishes and cephalopods (NOAA/NMFS 2008a).

Due to their preference for deeper water, this species is <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.10 Melon-headed whale (*Peponocephala electra*)

Melon-headed whales inhabit deep tropical waters throughout the world. Their main food sources include squid, fishes, and some crustaceans in moderately deep water. Although there is a designated western North Atlantic stock, only two sightings have been made in this region, and population estimates are not available (NOAA/NMFS 2008a; Waring et al. 2007, Waring et al. 2013).

Due to its rarity in the western North Atlantic and preference for deeper and warmer waters, this species is <u>not expected (highly unlikely) to occur</u> in the Project area.

4.1.3.11 Risso's dolphin (*Grampus griseus*)

Risso's dolphins inhabit tropical and temperate seas worldwide. In the western Atlantic, they occur from Florida to eastern Newfoundland (Waring et al. 2011). They are found in deep waters (>0.5 mi [>1,000 m] deep) seaward of the continental shelf and slope (NOAA/NMFS 2008a). Their primary food source is squid, but they eat numerous fish species as well (ACS 2008). The population occupies the mid-Atlantic continental shelf edge and slope year round. There are an estimated 15,197 individuals of Risso's dolphins in the western North Atlantic population (Waring et al. 2013).

Due to its preference for deeper water, Risso's dophins are <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.12 Bottlenose dolphin (*Tursiops truncatus*)

Bottlenose dolphins are found in temperate and tropical waters throughout the world. There are two morphotypes that vary in color and size: the coastal morphotype and the offshore morphotype. The distributions of the coastal and offshore morphotypes overlap, but coastal bottlenose dolphins are more likely to migrate into bays, estuaries, and river mouths, while the offshore dolphins tend to reside in deeper waters on the continental shelf (NOAA/NMFS 2008b). Coastal dolphins feed on benthic invertebrates and fish, while the offshore dolphins feed on pelagic squid and fish.

The coastal morphotype of the bottlenose dolphin inhabits the U.S. Atlantic coast from south of Long Island to Florida. Recent analyses of stranding statistics, genetics, photographic identification, and satellite telemetry data suggest that the coastal morphotype can be further subdivided into five coastal stocks, including a Northern Migratory stock which would be in the Project area (Waring et al. 2011). In the northern portion of this range, populations are more likely to be seasonal, migrating to the area in May and staying through October. The best minimum population estimate for the Coastal Northern Migratory stock is 9,604 individuals (Waring et al. 2013). There is also a Western North Atlantic Offshore stock, and the best minimum estimate for the stock is 81,588, though this number may include some sightings from the coastal stock (Waring et al. 2013).

Bottlenose dolphins <u>could occur (likely)</u> in the Project area, especially May through October.

4.1.3.13 Common dolphin (*Delphinus delphis*)

Short-beaked common dolphins are thought to be one of the most widely distributed cetaceans. They are found worldwide in temperate, tropical, and subtropical seas. The population in the western North Atlantic is estimated at 67,191 individuals (Waring et al. 2013). They feed on epipelagic schooling fish and cephalopods (e.g., squid) (NOAA/NMFS 2008a). Short-beaked common dolphins typically occur between the 328 and 6,562-ft (100 and 2,000-m) isobaths on the continental shelf off the coast of the north eastern United States (Waring et al. 2007), and NOAA Fisheries (2012b) depicts them as preferring waters between 650 and 6,500 ft (198 – 1,981 m) deep. Geo-Marine, Inc. (2010), reported sightings of common dolphins off the coast of mid-New Jersey along the 33 to 101-ft (10 to 31-m) isobaths.

Common dolphins <u>could occur</u> (likely) in the Project area, most likely in winter or spring.

4.1.3.14 Striped dolphin (*Stenella coeruleoalba*)

Striped dolphins are distributed in tropical to warm temperate waters worldwide. In the western North Atlantic, they are found from Nova Scotia south to at least Jamaica. Off the coast of the northeast United States, they are located on the continental shelf edge (primarily along the 0.5-mi [1,000-m] depth contour), and in the mid-Atlantic they also can occur over the continental slope and rise (Waring et al. 2007). Their diet is diverse and consists of benthopelagic and pelagic shoaling/schooling fish (e.g., myctophids and cod) and cephalopods (e.g., squid and octopus) (NOAA/NMFS 2008a). The population is estimated to be approximately 46,882 individuals in the western North Atlantic (Waring et al. 2013).

Due to their preference for deeper water on the continental shelf edge, striped dolphins are <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.15 Clymene dolphin (*Stenella clymene*)

Clymene dolphins are found in deep (820 to 16,404 ft, [250 to 5,000 m]), tropical and sub-tropical waters of the Atlantic (Waring et al. 2007, NOAA/NMFS 2008a). Their U.S. Atlantic distribution range is from New Jersey to Florida. They feed on small mesopelagic fish (e.g., myctophids) and cephalopods (e.g., squid). The size of the western North Atlantic stock is currently unknown (Waring et al. 2013).

Due to their preference for warmer waters, this species is <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.16 Atlantic spotted dolphin (*Stenella frontalis*)

Atlantic spotted dolphins are found in tropical and warm temperate waters of the western North Atlantic, from southern New England south to Venezuela. Off the northeast U.S. coast, they are found on the continental shelf, along the continental shelf edge, and, south of 40° N, over the deep ocean. At the latitude of the Project area, the species generally is found near the continental shelf edge and slope (Waring et al. 2007). They feed on small fish, benthic invertebrates, and cephalopods (e.g., squid and octopus)

(NOAA/NMFS 2008a). The population size from Maryland to the Bay of Fundy is estimated to be 3,578 (Waring et al. 2007). The best estimate for the Western North Atlantic stock is 26,798 (Waring et al. 2013).

Due to their preference for deeper water along the continental shelf edge, Atlantic spotted dolphins are <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.17 Spinner dolphin (*Stenella longirostris*)

Spinner dolphins occur in oceanic and coastal tropical waters worldwide. Their distribution in the Atlantic is very poorly understood. Sightings off the northeast U.S. coast have occurred exclusively in deep water (waters greater than 1.2 miles from shore and greater than 2,000 meters deep) (Waring et al. 2007). They feed primarily on mid-water fishes and deep-water squid (NOAA/NMFS 2008a). The western North Atlantic population size is currently unknown (Waring et al. 2013).

Due to its preference for deeper water along the continental shelf edge, Atlantic spotted dolphins are <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.18 Atlantic white-sided dolphin (*Lagenorhynchus acutus*)

Atlantic white-sided dolphins reside in temperate and sub-polar waters of the North Atlantic, from North Carolina to central West Greenland; however, they are concentrated off the coast of New England and northward. They prefer the relatively shallow continental shelf waters to the 328 ft (100 m) depth contour. There are thought to be three stock units for this species: Gulf of Maine, Gulf of St. Lawrence, and Labrador Sea stocks. The Gulf of Maine stock is most common from Hudson Canyon (located at a latitude of approximately 39° N, or the southern tip of New Jersey) to Georges Bank and in the Gulf of Maine and Bay of Fundy. Sightings off the coast of New York occur year-round but at low densities (Waring et al. 2013). They feed on fish (e.g., mackerel, herring, and hake), as well as squid and shrimp (NOAA/NMFS 2008a). The best estimate for population size of the western North Atlantic stock is 48,819 individuals (Waring et al. 2013).

Atlantic white-sided dolphins are <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.19 White-beaked dolphin (*Lagenorhynchus albirostris*)

The range of the white-beaked dolphin is more northerly than that of the Atlantic white-sided dolphin, extending from southern New England to southern Greenland; however, there have been occasional strandings on the New York coast. White-beaked dolphins prefer water depths less than 556 ft (200 m). They feed primarily on small mesopelagic and schooling fish (e.g., capelin, cod, haddock, hake, herring, and whiting), crustaceans, and cephalopods (e.g., squid and octopus) (NOAA/NMFS 2008a). The best estimate for the Western North Atlantic stock is 2,003 (Waring et al. 2013).

White-beaked dolphins are <u>not expected (unlikely) to occur</u> in the Project area.

4.1.3.20 Harbor porpoise (*Phocoena phocoena*)

Harbor porpoises are found in the United States and Canadian Atlantic waters. In the summer, they are concentrated in the northern Gulf of Maine and southern Bay of Fundy; however, in the fall and spring they are found from New Jersey to Maine, and in the winter they are found from New Jersey to North Carolina, with lower densities in waters from New York to New Brunswick, Canada (Waring et al. 2011). They can be spotted from the coastline to deep waters (greater than 5,906 feet [1,800 m]), but are concentrated on the continental shelf in waters less than 650 feet (less than 200 m). They are commonly found in bays, estuaries, and harbors of Maine. Limited evidence suggests that they prefer depths of approximately 300 ft (92 m). The southern-most population, the Gulf of Maine/Bay of Fundy population, is estimated at 79,833 individuals (Waring et al. 2013).

Harbor porpoises <u>could occur (likely)</u> in the Project area (Port and Mainline), most likely in spring and summer months.

4.1.3.21 Harbor seal (*Phoca vitulina*)

Harbor seals are the most common seals along the U.S. east coast (NOAA/NMFS 2008b) and are the most abundant seal found in New York State (NYSDEC 2012d). They reside in nearshore waters of the Atlantic Ocean above about 30° N. In the United States, they are found along the New England and New York coast and sometimes south to the Carolinas. They live year-round off the coast of eastern Canada and Maine, and they inhabit the more southern end of their range from September through late May (Waring et al. 2011). The New York Bight is a significant wintering area for harbor seals, and they are common in the waters and at several haul-out locations along the beaches of Long Island (NYSDEC 2012, CRESLI 2012). Populations of harbor seals along the southern shore of Long Island have been increasing since the early 2,000s, leading to a number of seal cruises that tour the coast of Long Island. Jamaica Bay Wildlife Refuge and Fire Island National Seashore are identified as two of the best places on Long Island to see harbor seals (NYSDEC 2012). Seasonal seal walks have been hosted by CRESLI at Cupsogue Beach County Park since 2001 (CRESLI 2012).

In the United States, breeding occurs off the coast of Maine, although they have also been reported as far south as New Jersey during breeding season (NJDEP 2006). They use rocks, reefs, beach, and drifting glacial ice as pupping and haul-out sites (NOAA/NMFS 2008b). They haul out on land to rest, increase body heat, give birth, and socially interact (NOAA/NMFS 2008b). The harbor seal population has been increasing over the last several decades and was estimated in 2001 to be approximately 99,340 individuals along the Maine coast (NOAA/NMFS 2008b; Waring et al. 2011). There is no current abundance estimate for harbor seals (Waring et al. 2013), and it is unknown how many seals inhabit waters south of Maine. The harbor seal diet consists of fish, shellfish, and crustaceans (NOAA/NMFS 2008b).

Because the New York Bight is a significant wintering area for harbor seals and they are common in nearshore waters, this species <u>could occur (likely)</u> in the Project area, especially September through May.

4.1.3.22 Gray seal (*Halichoerus grypus grypus*)

Distribution of gray seals in the western North Atlantic ranges from the coastal waters of New England to Labrador. Pupping generally occurs in Maine and northward, but pupping also has been observed in Nantucket Sound (Waring et al. 2007, CRESLI 2012). They haul out on isolated beaches and rocky ledges of islands, and they will also haul out and give birth on shore-fast and pack ice (Read et al. 2008). Breeding and pupping occur between late September and early March. The diet of gray seals includes benthic and demersal prey (fish, cephalopods, and mollusks) in coastal areas, as well as pelagic schooling fish (Read et al. 2008). There is insufficient available data to estimate the U.S. gray seal population size. In eastern Canada, the population estimate is 195,000 individuals (Waring et al. 2007). Although the range of the gray seal historically has been north of the Project area, USFWS (1997) reports that their range more recently has expanded into the New York Bight. Several hundred gray seals were recorded in surveys conducted off eastern Long Island (Waring et al. 2011). Though the U.S. gray seal population numbers are not known, the most recent NOAA stock assessment considers their range from September to May to include coastal areas south to central N.J. (Waring et al. 2013).

Gray seals <u>could occur (rarely)</u> in the Project area from September to May. If they did transit the Project area, it would be in low concentrations because they are generally found in more northern waters.

4.1.3.23 Harp seal (*Pagophilus groenlandicus*)

Harp seals are distributed throughout much of the Atlantic and Arctic Oceans (Waring et al. 2011). They feed on a wide range of crustacean and fish species (Read et al. 2008). In the western Atlantic, they primarily reside off the coast of eastern Canada, spending much of the year in pack ice (Waring et al. 2007; Read et al. 2008). They are highly migratory. Breeding occurs in mid-February to April, after which the seals migrate north to molt and then further north to their Arctic summer feeding grounds. In late September, they migrate south, usually to the Gulf of St. Lawrence or off the coast of Newfoundland; however, they occasionally migrate into U.S. waters. In recent years, the number of sightings and strandings in U.S. waters has increased from Maine to New Jersey. These sightings generally occur in January through May (Waring et al. 2011). The population estimate for the western North Atlantic stock is 6.9 million individuals, the vast majority of which occur in Canadian waters (Waring et al. 2011). Although the range of the harp seal historically has been north of the Project area, the USFWS (1997) reports that their range more recently has expanded into the New York Bight. Harp seals are seen on a regular basis at haul-outs along Long Island (CRESLI 2012b).

Harp seals* could occur *(rarely) in the Project area, though they do prefer more northern waters. Due to increased presence in the NY Bight, it is possible that they could transit the Project area, although very unlikely and at low concentrations.

4.1.3.24 Hooded seal (*Cystophora cristata*)

Hooded seals inhabit waters of the Atlantic and Arctic Oceans. They are thought to feed primarily on fishes and squid (Read et al. 2008). They prefer deeper waters and generally are found farther offshore than the harp seal (Waring et al. 2007). They whelp in March on pack ice off the coast of eastern Canada (Waring et al. 2007, Read et al. 2008). They live on the edge of pack ice throughout most of the year, following it north in the summer and south in the fall (Read et al. 2008). Hooded seals are highly migratory and occasionally are spotted as far south as Puerto Rico (Waring et al. 2007). Sightings from Maine to Florida are increasing in occurrence, with New England sightings occurring January through May and southeastern U.S. sightings occurring in summer and fall. Their population size for the western North Atlantic is estimated at 592,100 individuals (Waring et al. 2007). The current population estimate for the western north Atlantic is unknown (Waring et al. 2013). Although the range of the hooded seal historically has been north of the Project area, the USFWS (1997) reports that their range more recently has expanded into the New York Bight. Rare sightings of single hooded seals were recorded in 2008 and 2009 on Long Island (Cupsogue Beach) (CRESLI 2012b).

Given their preference for deep waters and rare occurrence near the Project area, hooded seals are <u>not expected (unlikely) to occur</u> in the Project area.

4.2 Sea turtles

Five species of sea turtles occur in the New York Bight (USFWS 1997) in the warmer months, beginning in May with the highest concentrations occurring from June to October (Table 4-2). All five species are listed as threatened or endangered under the ESA; the listed species are:

- Loggerhead sea turtle (*Caretta caretta*)
- Kemp's ridley sea turtle (*Lepidochelys kempi*)
- Green sea turtle (*Chelonia mydas*)
- Leatherback sea turtle (*Dermochelys coriacea*)
- Hawksbill sea turtle (*Eretmochelys imbricata*)

According to a letter dated August 12, 2013 by NOAA, provided in Appendix A, four of these species have the potential to transit the Project area. Presence of leatherback sea turtles, Kemp's ridley sea turtles, loggerhead sea turtles and green sea turtles are likely in the NY Bight in summer months, beginning in May with the highest concentrations occurring in the June to October period. Hawksbill sea turtles, due to their preference for warmer waters, would be unlikely to transit the Project area. The NY Bight is an important development habitat for the Kemp's ridley turtle and is a key feeding area for leatherback, green, and loggerhead sea turtles (USFWS 1997). Most turtles found in the area are juveniles, typically three to six years of age (USACE 2012).

Effective August 11, 2014, NOAA-NMFS designated critical habitat for the Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead sea turtles. Critical habitat includes a combination of nearshore reproductive habitat, wintering areas, breeding areas, migratory corridors, and Sargassum habitat stretching from Mississippi to the Florida Keys and north along the Atlantic coast to North Carolina. A total of 38 marine areas and 685 miles of shoreline (1,102 km) are designated as critical habitat (Final Rule 78 FR 39855 for marine areas and Final Rule 78 FR 39755 for coastal areas). In February 2010, the Department of Interior (DOI) and Department of Commerce were jointly petitioned to designate critical habitat for Kemp's ridley sea turtle's nesting habitat along beaches of the Texas coast and for marine habitats in the GoM and Atlantic Ocean. NMFS initiated its 5-year status review of the species in 2012 and the petition to designate critical habitat is still under review.

Table 4-2 Sea turtles documented to occur in the northwestern Atlantic Ocean and their expected occurrence in the Project Area

Common Name	Scientific Name	ESA Status	New York Bight Status	Expected Occurrence in Project Area
Loggerhead sea turtle	*Caretta caretta*	Threatened	A, S	**Possible occurrence (likely)** in the Port or Mainline area in summer months.
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	A, S	**Possible occurrence (likely)** in the Port or Mainline area in summer months.
Green sea turtle	*Chelonia mydas*	Threatened	C, S	**Possible occurrence (rare)** in the Port or Mainline area in summer months.
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	A, S	**Possible occurence (likely)** in the Port or Mainline area in summer months.
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	R	**Not expected to occur (highly unlikely).** Presence unlikely due to preference for warmer waters.

Sources:
USFWS and NMFS 1993
USFWS 1997
Neubert and Sullivan 2014
Notes:
A=Abundant, C=Common, R=Rare, S=Seasonal

4.2.1 Loggerhead sea turtle (*Caretta caretta*) – Threatened

Loggerhead sea turtles are globally distributed, occurring in temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd 1988). The majority of loggerhead nesting is in the Atlantic and Indian Oceans with two nesting aggregations with greater than 10,000 females nesting per year. One of these aggregations is in Florida and the other is in Oman (Baldwin et al. 2003, Ehrhart et al. 2003, Kamezaki et al. 2003, Limpus and Limpus 2003b, Margaritoulis et al. 2003).

Adult loggerheads are known to make considerable migrations from nesting beaches to foraging grounds. Loggerhead turtles travel to northern waters during spring and summer as water temperatures warm, and southward and offshore toward warmer waters in fall and winter. In the western Atlantic, waters as far north as 42^{o} N latitude are foraging habitats for juveniles and adults (Shoop 1987; Shoop and Kenney 1992; Ehrhart et al. 2003; Mitchell et al. 2003). In U.S. Atlantic waters, loggerheads commonly occur throughout the inner continental shelf from Florida to Cape Cod, Massachusetts (Braun-McNeill et al. 2008; Mitchell et al. 2003). Loggerheads have been observed in waters with surface temperatures of 7^{o}C to 30^{o}C, but water temperatures above11^{o}C are considered most favorable (Shoop and Kenney 1992; Epperly et al. 1995b). The presence of loggerhead sea turtles is also influenced by water depth. Aerial surveys of continental shelf waters north of Cape Hatteras, North Carolina indicated that loggerhead sea turtles were most commonly sighted in waters with bottom depths ranging from 22-49 m deep (Shoop and Kenney 1992). However, more recent survey and satellite tracking data support the theory that they occur in waters from the coast to beyond the continental shelf (Mitchell et al. 2003; Braun-McNeill and Epperly 2004; Mansfield 2006; Blumenthal et al. 2006; Hawkes et al. 2006, 2011; McClellan and Read 2007; Mansfield et al. 2009).

Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988; NMFS and USFWS 2008). Sub-adult and adult loggerheads prey on benthic invertebrates such as mollusks and crustaceans in hard bottom habitats (NMFS and USFWS 2008).

In coastal and marine waters, loggerhead turtles can be affected by the following anthropogenic stressors: discharge of pollutants; underwater explosions; dredging, offshore artificial lighting and noise; entrainment or impingement in power plants; entanglement or ingestion of marine debris; vessel traffic and strikes; poaching, interactions with commercial fisheries; and recreational boating and diving (NOAA 2013). Of these potential impacts, interactions with fisheries represent the greatest potential impact because of the number of individuals that are captured and killed in fishing gear each year (Finkbeiner et al. 2011). As with Kemp's ridley sea turtles, shrimp trawl fisheries account for the highest number of loggerhead sea turtles that are captured and killed, but they are also captured and killed in trawls, traps and pots, longlines, and dredges along the Atlantic coast of the U.S. In 2002, NMFS estimated that almost 163,000 loggerhead sea turtles are captured in shrimp trawl fisheries each year in the Gulf of Mexico, with 3,948 of those sea turtles dying as a result of their capture. Each year, several hundred loggerhead sea turtles are also captured in herring fisheries; mackerel, squid, and butterfish fisheries; monkfish fisheries; pound net fisheries, summer flounder and scup fisheries; Atlantic pelagic longline fisheries; and gillnet fisheries. Although most of these turtles are released alive, these fisheries capture about 2,000 loggerhead sea turtles each year, killing almost 700; and the effects of capture-related stress on the current or expected future reproductive success of sea turtles remains unknown.

In addition to the impacts offshore, a wide variety of anthropogenic activities are thought to adversely affect hatchlings and adult female turtles and their nesting habitats including the following: coastal development; placement of erosion control structures and other barriers to nesting; beachfront lighting; vehicular and pedestrian traffic; beach sand extraction and placement; coastal pollution; removal of native vegetation; poaching; and predation (NMFS and FWS 1998, 2008; Margaritoulis et al. 2003; NOAA 2013).

Loggerhead sea turtles <u>could occur (likely)</u> in the Project area in summer months.

4.2.2 Kemp's ridley sea turtle (*Lepidochelys kempii*) – Endangered

The Kemp's ridley sea turtle is found from the Gulf of Mexico and along the Atlantic coast of the U.S. (NMFS et al. 2011), as far north as the Grand Banks (Watson et al. 2004) and Nova Scotia (Bleakney 1955); and East to the Azores and eastern north Atlantic and Mediterranean of the species (Tomas and Raga 2008; Insacco and Spadola 2010). Although females rarely leave the Gulf of Mexico and adult males do not migrate, juveniles feed along the east coast of the United States up to the waters off Cape Cod, Massachusetts (Spotila 2004). Because of this migration, juvenile Kemp's ridley sea turtles are the second most abundant sea turtle found in the mid-Atlantic region from New England, New York, and the Chesapeake Bay, south to coastal areas off North Carolina (Morreale et al. 2007; TEWG 2000; Schmid 1998; Wibbels et al. 2005). In the fall, the juvenile turtles migrate south along the coast, forming one of the densest concentrations of Kemp's ridley sea turtles outside of the Gulf of Mexico (Musick and Limpus 1997).

The Kemp's ridley sea turtle prefers nearshore temperate waters shallower than 50 meters (NMFS and USFWS 2007c), although it is not uncommon for adults to be found in deeper waters (Byles 1989a; Mysing and Vanselous 1989; Renaud et al. 1996; Shaver et al. 2005; Shaver and Wibbels 2007b). Foraging areas have been documented along the U.S. Atlantic coast including in the shallower waters of the Long Island Sound (Morreale and Standora 1993; Morreale et al. 2005).

The majority of Kemp's ridley sea turtles nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; NMFS and USFWS 2007c; NMFS et al. 2011). The number of recorded nests reached an estimated low of 702 nests in 1985, corresponding to fewer than 300 adult females nesting (TEWG 2000; NMFS and USFWS 2007c; NMFS et al. 2011). Conservation efforts since that time by Mexican and U.S. agencies eliminated egg harvest, protected eggs and hatchlings, and reduced at-sea mortality through fishing regulations (TEWG 2000). Since the mid-1980s, the number of nests observed at Rancho Nuevo and nearby beaches has increased 14%-16% per year (Heppell et al. 2005). An estimated 5,500 females nested in Tamaulipas, Mexico over a three-day period in May 2007 with more than 4,000 of those nesting at Rancho Nuevo (NMFS and USFWS 2007c). In 2008, 17,882 nests were documented on Mexican nesting beaches (NMFS 2011b).

Like other sea turtle species, the Kemp's ridley population has been influenced by a combination of exploitation of eggs, impacts from fishery interactions, loss of foraging habitat, and marine pollution. From the 1940s through the early1960s, nests from Rancho Nuevo were heavily exploited, but beach protection in 1967 helped to curtail this activity (NMFS et al. 2011).

Kemp's ridley sea turtles have been captured and killed by fishing gear throughout their range. They have been captured in gear used in lobster fisheries and monkfish fisheries off the northeastern United States, pound net fisheries off eastern Long Island, the mid-Atlantic and Chesapeake Bay; fisheries for squid, mackerel, butterfish, bluefish, summer flounder, Atlantic herring, weakfish, and the sargassum (NOAA 2013). The most significant fishery-related threat to Kemp's ridley sea turtles has been the number of sea turtles that have been captured and killed in the shrimp trawl fisheries in the Gulf of Mexico, although modifications to shrimp trawls have helped to reduce mortality of Kemp's ridleys sea turtles (NOAA 2013). Finkbeiner et al. (2011) compiled cumulative bycatch information in U.S. fisheries from 1990 through 2007. In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures).

Other impacts to the species have also been observed. For example, impingement/intake mortalities were documented at a nuclear power plant in NJ from 1992-2006 (NMFS 2006b), and the impacts of coastal dredging remains a concern (NOAA 2013). NMFS' biological opinions in the recent past have required non-dredging "windows" to protect nesting females as well as relocation trawls that precede dredging equipment to relocate turtles out of the dredge path (NOAA 2013).

Juvenile Kemp's ridley sea turtles <u>could occur (likely)</u> in the Project area in warmer months when they migrate north.

4.2.3 Green sea turtle (*Chelonia mydas*) – Threatened

Green sea turtles are distributed worldwide, and can be found in the Pacific, Indian, and Atlantic Oceans, primarily in tropical or subtropical waters (NMFS and USFWS 1991 and 2007d). Because green turtles appear to prefer waters that are above 18- 20^{o}C they are not normally found in the Project area in winter. In warmer summer months, in the western Atlantic, juvenile and adult green sea turtles occur seasonally along the Eastern U.S. coast and can be found as far North as Massachusetts (Wynne and Schwartz 1999), and as such, have been documented in the Long Island Sound (Musick and Limpus 1997; Morreale and Standora 1998; Morreale et al. 2005).

Historically, the primary cause of the global decline of green sea turtles populations was the number of eggs and adults captured and killed on nesting beaches and in coastal areas. Even today, some populations of green sea turtles are harvested by subsistence hunters or illegally by poachers. Green sea turtles were once directly harvested in U.S. fisheries, but that is no longer the case.

Another main cause of green sea turtle mortality is from incidental death due to fisheries entanglement. Other activities like channel dredging, marine debris, aquatic pollution, vessel strikes, power plant impingement, and habitat destruction account for additional mortalities, though these numbers have not been quantified (NOAA 2013). Stranding reports indicate that between 200-400 green sea turtles strand annually along the eastern U.S. coast from a variety of causes, most of which are unknown (STSSN database).

Conservative estimates are that green turtle populations have declined by 34% to 58% during the last 150 years (Seminoff 2002), though actual declines may be as high as 70% or 80% (NOAA 2013). Causes for these declines include continued harvest of eggs, sub-adults and adults in some countries, incidental take by fisheries, loss of habitat, and disease. While some nesting populations of green turtles appear to be stable or increasing in the Atlantic Ocean, declines of over 50% have been documented in the eastern and western Atlantic (NOAA 2013).

Green turtles <u>could occur (rare)</u> in the Project area in summer months when waters are above 18 or 20^{o}C.

4.2.4 Leatherback sea turtle (*Dermochelys coriacea*) – Endangered

Leatherback sea turtles are widely distributed throughout the oceans of the world, including the Atlantic, Pacific, and Indian Oceans (Casale et al. 2003; Ernst and Barbour 1972; Hamann et al. 2006b). Leatherback sea turtles have evolved physiological and anatomical adaptations that allow them to exploit colder waters (Frair et al. 1972; Greer et al. 1973; NMFS and USFWS 1995); and so their Northern Atlantic range includes areas as far north as the North and Barents Seas and Newfoundland and Labrador (Goff and Lien 1988; Hughes et al. 1998; Luschi et al. 2003; Luschi et al. 2006; Márquez 1990; Threlfall 1978).

Leatherback sea turtles are highly migratory, exploiting convergence zones and upwelling areas in the open ocean and along continental margins (Morreale et al. 1994; Eckert 1998; Eckert 1999). In the North Atlantic Ocean leatherback turtles occur regularly in deep waters, and in a single year, can swim more than 6,000 miles (10,000 kilometers) (Eckert 1998). An aerial survey in the North Atlantic observed leatherback turtles in continental shelf and pelagic environments in offshore waters ranging from 7-27^{o} C (Cetacean and Turtle Assessment Program [CeTAP] 1982), though juveniles prefer warmer and more tropical waters with temperatures above 21^{o} C (Eckert 2002).

Leatherback turtles are predominately pelagic, foraging widely in temperate waters except during nesting season, when females return to tropical beaches to lay eggs. Males are rarely observed near nesting areas, and it is thought that leatherback sea turtles mate outside of tropical waters, before females swim to their nesting beaches (Eckert and Eckert 1988). Based on genetic studies, Atlantic Ocean leatherbacks are currently being divided into seven breeding populations (Turtle Expert Working Group [TEWG] 2007).

Globally, leatherback turtle populations have declined worldwide and many local populations are in danger of extinction (NMFS 2001b; NMFS 2001a). Increases in the number of nesting females have been noted at some sites along coasts of the Atlantic Ocean, but these increases are far outweighed by declines in other parts of the world. Spotila et al. (2004b) estimated the global population of female leatherback turtles to be

35,860 individuals (confidence limits: 26,200 to 42,900), and recent data suggests that the Western Atlantic populations declined from 18,800 nesting females in 1996 (Spotila et al. 1996) to 15,000 nesting females by 2000 (NMFS 2001).

The greatest anthropogenic threats to leatherback sea turtles are from entanglement in fishing gear (e.g., gillnets, longlines, lobster pots), direct harvest of adults, sub-adults and eggs, the degradation of nesting and coastal habitats, vessel collisions, impacts of underwater sound, and ingestion of marine debris (NMFS and USFWS 2007, TEWG 2007). Other possible causes of decline include: domesticated animal predation; artificial lighting on beaches that disorients adult female and hatchling sea turtles; beach replenishment activities that destroy habitat; and possibly environmental contaminants (NMFS and USFWS 2007).

Leatherback sea turtles are thought to be the most vulnerable species of sea turtles to entanglement in fishing gear (Finkbeiner 2011).This susceptibility could be the result of their body type, diving and foraging behavior, distributional overlap with gear, possible attraction to organisms and algae that collect on buoys and buoy lines, or to the light sticks used to attract target species in longline fisheries (NOAA 2013).

Leatherbacks may be more susceptible to marine debris ingestion than other sea turtle species due to the tendency of floating debris to concentrate in convergence zones that juveniles and adults use for feeding (Shoop and Kenney 1992; Lutcavage et al. 1997). Necropsy results of leatherback sea turtles revealed that a substantial percentage (34% of the 408 leatherback necropsies conducted from 1885 and 2007) reported plastic within the turtle’s stomach, and in some cases (8.7%) blockage of the gut was found in a manner that may have caused the mortality (Mrosovsky et al. 2009).

Leatherback sea turtles <u>could occur (likely)</u> in the Project area in summer months.

4.2.5 Hawksbill sea turtle (*Eretmochelys imbricate*) – Endangered

Hawksbill sea turtles are distributed throughout tropical and subtropical waters of the Atlantic, Indian, and Pacific oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean, with individuals from several life history stages occurring regularly along southern Florida and the northern Gulf of Mexico; in the Greater and Lesser Antilles; and along the Central American coast south to Brazil (Amos 1989). Off the east coast of the U.S. hawksbill sea turtles have been reported in stranding data and alive from the waters off Florida to Massachusetts; however, sightings of hawksbill sea turtles north of Florida are rare (Wallace et al. 2010). Within the continental United States, hawksbill sea turtles nest only on beaches along the southeast coast of Florida and in the Florida Keys.

The greatest anthropogenic threats to hawksbill sea turtles are harvest of animals, incidental capture in commercial fisheries, and human development of the coast.

Because of their rare occurrence north of Florida waters, hawksbill sea turtles <u>are not expected (highly unlikely) to occur</u> in the Project area.

4.3 Fish

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) is the only ESA listed fish species known to be present in the waters of the NY Bight year-round with five distinct population segments (DPSs) listed as endangered or threatened under the ESA. According to NOAA, all four endangered DPSs: (1) New York Bight DPS, (2) Chesapeake Bay DPS, (3) Carolina DPS, and (4) South Atlantic DPS; and one threatened population, Gulf of Maine DPS could occur in the Project area (see Appendix A; NOAA letter dated August 12, 2013). Although Atlantic sturgeon have the potential to transit through the Project area they are not likely to remain in the area due to the lack of foraging habitat near the proposed Project site.

Atlantic sturgeon is a subspecies of sturgeon distributed along the eastern coast of North America from Hamilton Inlet, Labrador, Canada to the Saint Johns River in Florida (Smith and Clugston 1997, Atlantic

Sturgeon Status Review Team [ASSRT] 2007). Historically, Atlantic sturgeon were present in approximately 38 rivers in the United States from St. Croix, ME to the Saint Johns River, FL, of which 35 rivers have been confirmed to have had historic spawning populations. Atlantic sturgeon is currently present in 36 rivers, and spawning occurs in at least 20 of these. Other estuaries along the coast formed by rivers that do not support Atlantic sturgeon spawning populations may still be important rearing habitats.

Atlantic sturgeon are long lived, late maturing, estuarine dependent, anadromous fish. Atlantic sturgeon spawn in freshwater, but spend most of their sub-adult and adult life in the marine environment. Spawning is believed to occur in flowing water between the salt front of estuaries and the fall line of large rivers.

Studies suggest that young-of-year, age-1, and age-2 juvenile Atlantic sturgeon occur in low salinity waters of the natal estuary (Haley 1999; Hatin et al. 2007; McCord et al. 2007; Munro et al. 2007). Atlantic sturgeon remain in the natal estuary for months to years before emigrating to open ocean as subadults (Holland and Yelverton 1973; Dovel and Berggen 1983; Waldman et al. 1996; Dadswell 2006; ASSRT 2007). After emigration from the natal estuary, subadults and adults travel within the marine environment, where they may undergo extensive movements usually confined to shelly or gravelly bottoms in 10-50 m (33-164 ft) water depths (Stein et al. 2004; Erickson et al. 2011). Fish distribution varies seasonally within this depth range. During summer months (May to September) fish are primarily found in the shallower depths of 10-20 m (33-66 ft). In winter and early spring (December to March), fish move to depths between 20 and 50 m (66 and 165 ft) (Erickson et al. 2011). Atlantic sturgeon commonly aggregate in the Connecticut River estuary, Long Island Sound and New York Bight.

The Atlantic sturgeon fishery was closed by the Atlantic States Marine Fisheries Commission in 1998, when a coastwide fishing moratorium was imposed for 20-40 years, or at least until 20 year classes of mature female Atlantic sturgeon were present (Atlantic States Marine Fisheries Commission [ASMFC] 1998).There are no current, published population abundance estimates for any of the currently known spawning stocks. Therefore, there are no published abundance estimates for any of the five DPSs of Atlantic sturgeon. An estimate of 863 mature adults per year (596 males and 267 females) was calculated for the Hudson River based on fishery-dependent data collected from 1985-1995 (Kahnle et al. 2007).

The main anthropogenic threat to Atlantic sturgeon is from mortalities associated with bycatch in fisheries. Other possible threats include ship strikes, channel dredging, dams and poor water quality. Ship strikes have been documented in the Delaware River, James River and Hudson River ecosystems (NOAA 2013). Dredging can affect sturgeon by removing food resources, eliminating high quality habitat, or directly killing fish by the dredging itself. The presence of dams could impact connectivity and impact Atlantic sturgeon spawning and juvenile developmental habitat. Atlantic sturgeon are also sensitive to pesticides, heavy metals, and other toxins in the aquatic environment. More detailed information on threats to Atlantic sturgeon can be found in the status review (Atlantic Sturgeon Status Review Team 2007).

Atlantic Sturgeon could occur (likely) in the Project are, but only as transients.

4.4 Estimated abundance and seasonality of potentially occurring protected species

As outlined above, nine species of marine mammals (three whales, two dolphins, one porpoise, and three seals) could occur in the Project area. Three of these marine mammals are whales that are listed under the ESA as endangered, including the following species: fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and the North Atlantic right whale (*Eubalaena glacialis*). In addition to these ESA-listed species, six additional marine mammals protected under the MMPA have the potential to transit the Project area (Port and Mainline): harbor porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphis*), harbour seal (*Phoca vitulina*), gray seal (*Halichoerus grypus*), and harp seal (*Pagophilus groenlandicus*). Leatherback sea turtles, Kemp's ridley sea turtles, loggerhead sea turtles, green sea turtles and the five Atlantic Sturgeon DPSs could also transit the Project area in certain months. Tables 4-3 and 4-4 summarize the potential abundance by season for the nine species of marine mammals, four species of turtles and Atlantic Sturgeon DPSs outlined above that could occur in the Project area (Neubert and Sullivan (2014); based on values presented in Legueux et al. 2010).

Table 4-3 Potential abundance (by season) for marine mammals, sea turtles and Atlantic sturgeon that could potentially occur in the project area during construction and operations

Species	Seasonal Relative Abundance	Port Footprint				Mainline Footprint			
		Spring	Summer	Winter	Fall	Spring	Summer	Winter	Fall
North Atlantic right Whale	rare	0-1.4	0-1.4	0-1.4	0-1.4	0-1.4	0-1.4	0-1.4	0-1.4
Fin Whale	low to very abundant	23-45	23-45	23-45	0-22	23-45	23-45	23-112	0-22
Humpback Whale	rare to common	0-20	0-20	0-20	21-40	0-20	0-20	0-20	21-61
Bottlenose Dolphin	rare to low	0-747	0-747	0-747	0-747	0-747	0-1495	0-747	0-747
Common Dolphin	rare to low	2197-4393	0-2196	2197-4393	0-2196	0-4393	0-2196	0-4393	0-2196
Harbor Porpoise	rare to very abundant	12-16	6-11	0-5	0-5	17-27	0-11	0-5	0-5
Seals	rare to low	1294-2586	0-1293	0-1293	0-1293	1294-2586	0-1293	0-1293	0-1293
Leatherback Turtle	rare to very abundant	0-8	25-32	0-8	9-16	0-8	33-40	0-8	0-16
Loggerhead Turtle	rare to low	0-119	120-237	0-119	120-237	0-119	120-237	0-119	120-237
Kemp's Ridley Turtle	rare to common	0-13.9	0-27.8	0-13.9	0-13.9	0-13.9	14-41.7	0-13.9	0-13.9
Green Turtle	rare	ND	ND	ND	ND	ND	ND	ND	ND
Atlantic Sturgeon	rare	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6

Abundance estimates are presented as ranges (by season) in Neubert and Sullivan (2014) and are based on values presented in Legueux et al. 2010)
ND=No data presented for green turtles in the above reports.

Table 4-4 Seasonal trends (by month) of the likely occurrence of MMPA protected and/or ESA listed species that could potentially occur (transit) the Project area.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine mammals												
North Atlantic right whales	R	R	R	R							R	R
Humpback whales	R	R	R	R	R	R	R	R	✓	✓	✓	R
Fin whales	✓	✓	✓	✓	✓	✓	✓	✓	R	R	R	✓
Bottlenose dolphins					✓	✓	✓	✓	✓	✓		
Common dolphin	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Harbor porpoises	✓	✓	✓	✓	✓	✓				✓	✓	✓
Harbor seals	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Gray seals	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Harp seals	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Sea Turtles												
Kemp's Ridley sea turtle						✓	✓	✓	✓	✓		
Green sea turtle						R	R	R	R	R		
Leatherback sea turtle						✓	✓	✓	✓	✓		
Loggerhead Sea Turtle						✓	✓	✓	✓	✓		
Fish												
Atlantic Sturgeon	R	R	R	R	R	R	R	R	R	R	R	R

Note: R = Rare transient
Sources:
Waring et al. 2013
Neubert and Sullivan 2014

5.0 Noise Exposure Criteria

5.1 Marine mammals

5.1.1 Marine mammals and underwater sound

Marine mammals live in an environment in which vision is not the primary sense because light does not penetrate far beneath the surface of the ocean. As such, marine animals often rely upon sound, instead of sight, as their primary sense for communication and awareness of their environment. Marine mammal communication has a variety of functions such as mother/calf cohesion, group cohesion, individual recognition and danger avoidance.

5.1.2 Hearing sensitivity in marine mammals

Species of cetaceans and pinnipeds were assigned to functional hearing groups based on their hearing characteristics by Southall et al. (2007). Each functional hearing group has been assigned an M-weighting function to account for the fact that marine mammals do not hear equally well at all frequencies within their functional hearing range. M-weighting functions de-emphasize frequencies that are near the lower and upper frequency end of the estimated hearing range, where noise levels have to be higher to result in the same auditory effect (Southall et al. 2007). The M-weighting functions are similar in intent to the C weighting function that is commonly used when assessing the impact of high-amplitude sounds on humans.

NOAA's Draft Guidance suggests revision to the M-weighting functions and functional hearing groups to account for new research findings; both expanding the upper hearing range of low frequency cetaceans, and splitting pinnipeds into two families.

Table 5-1 presents the estimated auditory bandwidth, species relevant to this assessment and the M-weighting function applicable for this functional hearing group.

Table 5-1 Marine mammal functional hearing groups from NOAA Draft Guidance (NOAA 2014)

Functional Hearing Group	Estimated Auditory Bandwidth	Relevant Species to Port Ambrose Project	Functional Hearing Group M-Weighting
Low frequency (LF) cetaceans	7 Hz – 30 kHz	North Atlantic right whale Humpback whale Fin whale	M_{lf}
Mid frequency (MF) cetaceans	150 Hz – 160 kHz	Bottlenose dolphin Common dolphin	M_{mf}
High frequency (HF) cetaceans	200 Hz – 180 kHz	Harbor porpoise	M_{hf}
Phocid pinnipeds (seals)	75 Hz – 100 kHz	Harbor seal Harp seal Gray seal	M_{pp}
Note: Species-specific hearing information for marine mammal species is presented in Section 4 (above).			

Revised cetacean M-weighting functions (M_{lf}, M_{mf}, M_{hf}, and M_{pp}) were developed by NOAA incorporating new research on marine mammal hearing.

The revised M_{lf} function utilizes research from Ketten (1998), Houser et al. (2001), and Tubelli et al. (2012) combining an Equal Loudness Function for LF cetaceans with the previous M-weighing curves from Southall et al. (2007). The resulting M_{lf} frequency weighting function for LF cetaceans is more sensitive to noise at frequencies between approximately 30Hz and 10kHz when compared to the previous M-weighting curve.

The revised M_{mf} and M_{hf} weighting functions use a similar approach, combining Equal Loudness Functions with the previous M-weighting curves from Southall et al. (2007). For MF cetaceans the equal loudness function was derived from measurements of Bottlenose Dolphin by Finneran and Schlundt (2011) and frequency specific TTS data from Finneran and Schlundt (2009); Finneran and Schlundt (2010); and Finneran and Schlundt (2013).

Equal loudness data was not available for HF cetaceans. To develop a revised M_{hf} function, NOAA extrapolated the cut-off frequencies of both the MF cetacean equal loudness function and the previous M-weighting function using an approach based upon octave spacing from ANSI (1994) and frequency perception detailed in Yost (1994) and Ketten (2000).

The M_{pp} weighting function for phocid pinnipeds underwater does not incorporate an equal loudness function curve, as EQL measurements have not been undertaken on any pinniped species. NOAA has extended the upper functional hearing range of the pinniped curve proposed by Southall et al. (2007) to reflect research by Hemilä et al. (2006) and Kastelein et al. (2009). An upper cut-off frequency of 100 kHz (previously 75 kHz) is specified for phocid pinnipeds in the Draft Guidance.

5.1.3 Noise exposure criteria for marine mammals

NOAA's Draft Guidance is anticipated to form the applicable criteria for assessing underwater noise impacts on marine mammals. The Guidance proposes dual criteria, utilizing both dB_{peak} and SEL_c metrics, with assessment to be based upon whichever criterion is exceeded first. Both M-weighted and unweighted SEL criteria are provided; however, NOAA notes that the unweighted SEL criteria are likely to result in an overly conservative assessment, as they do not take into account the hearing sensitivity of the receiver functional hearing group. Table 5-2 outlines the criteria from the Draft Guidance which have been adopted for this assessment.

Table 5-2 Applicable underwater noise criteria for cetaceans (excerpt from Table 6 of NOAA's Draft Guidance)

Hearing Group	PTS Onset (Level A Harassment)		TTS Onset (Level B Harassment)	
	Impulsive	Non-impulsive	Impulsive	Non-impulsive
LF Cetaceans	230 dB_{peak} 187 $dB(M_{lf})$ SEL_c	230 dB_{peak} 198 $dB(M_{lf})$ SEL_c	224 dB_{peak} 172 $dB(M_{lf})$ SEL_c	224 dB_{peak} 178 $dB(M_{lf})$ SEL_c
MF Cetaceans	230 dB_{peak} 187 $dB(M_{mf})$ SEL_c	230 dB_{peak} 198 $dB(M_{mf})$ SEL_c	224 dB_{peak} 172 $dB(M_{mf})$ SEL_c	224 dB_{peak} 178 $dB(M_{mf})$ SEL_c
HF Cetaceans	201 dB_{peak} 161 $dB(M_{hf})$ SEL_c	201 dB_{peak} 180 $dB(M_{hf})$ SEL_c	195 dB_{peak} 146 $dB(M_{hf})$ SEL_c	195 dB_{peak} 160 $dB(M_{hf})$ SEL_c
Phocid Pinnipeds	235 dB_{peak} 192 $dB(M_{pp})$ SEL_c	235 dB_{peak} 197 $dB(M_{pp})$ SEL_c	229 dB_{peak} 177 $dB(M_{pp})$ SEL_c	229 dB_{peak} 183 $dB(M_{pp})$ SEL_c

Notes:

(1) All levels are expressed in linear dBpeak re 1µPa (dBpeak) or M-weighed dB re 1 µPa2s (SELc) applicable at the receiver location.

(2) Noise is to be assessed on the basis of whichever criterion is exceeded first.

5.2 Sea turtles

5.2.1 Hearing in sea turtles

Little is known about how sea turtles make use of sound in both terrestrial and underwater environments. However, as more research emerges on the physiology of turtle auditory systems and the auditory response of turtles, it is suggested that turtles likely use sound for navigation, location of predators/prey, and environmental awareness (Piniak et al. 2012).

Bartol et al. (1999) and Ridgway et al. (1969) suggest that turtle hearing was most sensitive to frequencies below 1,000 Hz when subject to airborne noise. The study by Piniak et al. (2012) agrees with these conclusions for airborne noise, however it concludes that turtles are likely to be able to detect higher frequencies underwater, with tests on juvenile green turtles showing response to stimuli up to 1,600 Hz.

Information on loggerhead turtle hearing is very limited. Bartol et al. (1999) studied the auditory evoked potential of loggerhead sea turtles and concluded that loggerhead sea turtles had the most sensitive hearing between 250 and 1,000 Hz, with rapid decline above 1,000 Hz (Bartol et al. 1999, Lenhardt 1994; Lenhardt et al. 1983; Moein Bartol and Ketten 2006; Moein Bartol et al. 1999; O'Hara and Wilcox 1990).

Information on green turtle hearing is limited. Ridgway et al. (1969) studied the auditory evoked potentials of three green sea turtles and concluded that their maximum sensitivity occurred from 300 to 400 Hz with rapid declines for tones at lower and higher frequencies. In a study of the auditory brainstem responses of subadult green sea turtles, responses to frequencies between 100 and 500 Hz occurred; with highest sensitivity between 200 and 400 Hz (Bartol and Ketten 2006). Currently, the upper hearing limit for green turtles is thought to be between 400 and 1600 Hz in water, with maximum sensitivity occurring between 50 and 400 Hz for juvenile green turtles (Piniak et al. 2012).

There is no information on Kemp's ridley sea turtle or leatherback sea turtle hearing, however, it is assumed that their hearing sensitivities are similar to those of green and loggerhead sea turtles with their best hearing sensitivity in the low frequency range from 50 to 400 Hz with rapid declines for tones at lower and higher frequencies with an upper limit of about 1,600 Hz in water (Piniak et al. 2012).

5.2.2 Noise exposure criteria for turtles

There are no published underwater noise criteria for turtles in U.S. waters. Young (1991), cited in Keeven & Hempen (1997) provides an empirical safety range equation for underwater explosions from military activities for a variety of marine fauna, including turtles. The safety range was based on Gulf of Mexico oil platform criteria established by the NMFS.

Keeven & Hempen (1997) also provide details of two cases where physical injury was reported in turtles unintentionally exposed to underwater explosions, with details of the charge weight and approximate distance the injured turtle was from the blast. Substituting the values from these cases into the equations from Young (1991) gives an equivalent peak noise safety level for turtles of 222 dBpeak re 1 µPa. We have adopted this level as the harm criterion for turtles (Table 5-3).

Behavioral criterion is derived from McCauley et al. (2000) who conducted tests on Green and Loggerhead Turtles that showed increased swimming behavior when exposed to noise from air guns between levels of 166 – 75 dB_{rms} re 1 µPa (Table 5-3).

Table 5-3 Underwater noise criteria for sea turtles

Hearing group	Non-auditory or auditory injury (Harm)	Behavioral response (Harassment)
Sea turtles	222 dB_{peak}	175 dB_{rms}
Notes: All levels are expressed in linear dB_{peak} re 1μPa or linear dB_{rms} re 1μPa, applicable at the receiver location		

5.3 Fish (Atlantic Sturgeon)

5.3.1 Hearing in fish

An important function of fish hearing is to learn about their surrounding environment, a process referred to as sampling of the 'acoustic scene' in the same manner as other vertebrates (Bregman 1991). Awareness of the acoustic scene allows fish to learn more about their environment than from visual inspection alone because light does not travel far underwater. Besides using sound for understanding their physical environment, fish also use sound to communicate, locate prey, and avoid predators.

Sensitivity to noise and vibration differs among fish species according to the anatomy of the swim bladder and its proximity to the inner ear. Fish species are typically divided into two broad groups—specialists and generalists—based on their different levels of hearing specialization (Hastings and Popper 2005).

Hearing generalists sense acoustic energy directly through their inner ear and also from their swim bladder if present. Hearing specialists have evolved specialized auditory systems which generally include one of a number of different mechanisms to couple the swim bladder or other gas-filled structure (prootic bulla) to the inner ear (Nedwell et al 2004). The swim bladder or gas-filled structure functions as a pressure transducer that re-radiates acoustic energy in the form of particle motion that can be detected by the inner ear. This increases hearing sensitivity in comparison to hearing generalists and generally makes them more susceptible to noise.

Information about the hearing range of Atlantic sturgeon is inferred from studies concerning other species of sturgeon (Meyer and Popper 2003 and 2005). The Bureau of Ocean Energy Management (BOEM) (2012c) categorizes sturgeon, in general, as fishes that detect sounds from below 50 Hz to perhaps 800-1,000 Hz (though several probably only detect sounds to 600-800 Hz). These fish have a swim bladder, but no known structures in the auditory system that would enhance hearing, and their sensitivity (lowest sound detectable at any frequency) is not very great, hence they are considered generalists. Sounds would have to be more intense to be detected compared to fishes with swim bladders that enhance hearing. Sturgeon can detect both particle motion and pressure.

5.3.2 Effects of underwater sound on fish (Atlantic Sturgeon)

Underwater noise effects on fish can include alteration of behavior, damage to auditory and non-auditory tissue, and mortality. The level of impact depends on the intensity and character of the noise, the distance to the noise source, and the size, mass and anatomical characteristics of the fish species (Hastings and Popper 2005).

Damage to the sensory hair cells of the ear and temporary threshold shift (TTS) may be caused by exposure to low noise levels for a prolonged period or high noise levels for a short period. There is some evidence that fish can replace or repair damaged sensory hair cells (ICF Jones and Stokes 2009). It has also been found that fish are able to recover from TTS in less than 18 hours after exposure.

A temporary reduction in hearing sensitivity or damage to auditory tissue can also cause indirect behavioral effects (Hastings and Popper 2005), though these indirect behavioral impacts are poorly understood in most species of fish.

The pressure pulses generated by high energy noise sources, such as blasting and pile driving of large diameter piles, can cause the swim bladder of fish to rupture or tear (Hastings and Popper 2005). This generally only occurs in the immediate vicinity of the source where the pressure rises and reduces quickly to its positive and negative peak pressure level. The sudden increase and decrease in pressure level causes gas oscillations that can rupture or tear the swim bladder.

Other non-auditory tissue damage that has been investigated includes capillary ruptures or eye hemorrhage caused by gas bubbles formed in the blood or eye tissue due to high noise levels, neurotrauma causing loss of consciousness, and in some cases mortality (Hastings and Popper 2005). Generally, smaller fish are more susceptible to non-auditory tissue damage than larger fish.

5.3.3 Noise exposure criteria for fish

There are no published underwater noise criteria for Atlantic sturgeon. As stated above the BOEM (2012c) categorizes sturgeon, in general, as fishes that detect sounds from below 50 Hz to perhaps 800-1,000 Hz.

The injury criteria for fish from piling driving often cited comes from the FHWG criteria (2008). This guidance document reports 206 dBpeak re 1 μPa as peak level and 187 dB re 1 μPa2s cumulative SEL for fish over 2 grams. Because data on hearing capabilities exist for perhaps only 100 of the 29,000 or more extant species of fish (Popper et al. 2003), any extrapolation of hearing capabilities between different species, and especially those that are taxonomically distant must be done with the greatest caution (ICF Jones & Stokes 2009).

The FHWG criteria does not address behavioral effects of pile driving noise on fish, as little is known regarding the threshold levels for such effects. As a conservative measure, NOAA Fisheries and USFWS generally have used SPL 150 dB re 1 μPa as the threshold for behavioral effects to ESA-listed fish species (salmon and bull trout) for most biological opinions evaluating pile driving, citing that sound pressure levels in excess of SPL 150 dB re 1 μPa can cause temporary behavioral changes (startle and stress) that could decrease a fish's ability to avoid predators (ICF Jones & Stokes 2009). Because no data on behavioral shifts in Atlantic sturgeon due to noise from similar construction activity exists, harassment distance for Atlantic sturgeon is not estimated in this report.

6.0 Summary of JASCO Underwater Modelling

Underwater noise modelling for the Project has been undertaken by JASCO Applied Sciences (JASCO). This section provides a brief overview of the JASCO modelling inputs and process, and a summary of the results relevant to this assessment. We have based this summary and our assessment on JASCO's 2014 report: *Underwater and in-air modelling study for construction and operation activities (NOAA Criteria Edition)*.

6.1 Model inputs

Construction noise source levels were estimated from previous measurements of similar equipment by JASCO, and scaled using the ratio of propulsion power (e.g., horsepower) of the measured and specified equipment. Suction piling source levels were assumed to be negligible to noise from the Heavy Lift Vessel and other associated construction equipment. In comparison, source levels for the unlikely impact pile driving alternative were estimated based on review and analysis of published sound level measurements from the available literature. For vessel source levels JASCO utilized source levels obtained from equivalent field measurements or from third party reports for their modelling effort.

Suction pile driving is performed using a pump that evacuates the water from the inside of a sealed pile. The pile driving force in this case results from the pressure difference. The noise source level of the pump is estimated to be low, about 138 dB re 1 µPa at 1 m (Laurinolli et al. 2005). The noise from the Heavy Lifting Vessel assisting the operation can therefore be considered as the dominating noise source during this activity and the noise from the water pump can be disregarded.

There is a remote possibility that impact pile driving might be needed should future geotechnical studies show that suction piling is not feasible at one ore more anchor locations instead of the planned suction piling. JASCO estimated source levels for impact piling on published sound level measurements. Impact piling source levels and 1/3 octave source spectra were derived from empirical equations given by MacGillivray et al. (2001) and estimated impact rates and piling timing from the Project's piling contractor. Impact piling sources were modelled at a depth of 7 meters below the sea surface.

Source levels for the LNGRV propulsion system were adopted from measured data of a similar vessel (*Suez Neptune* (HN1688)) as measurements of the proposed LNGRV vessel should be similar in magnitude as both vessels use the same propulsion system. JASCO used the measured data and adopted a suitable relative 1/3 octave band spectrum. The LNGRV source was modelled at a depth of 7 meters below the sea surface.

Bathymetry data was obtained from the National Geophysical Data Center's U.S. Coastal Relief Model, and geo-acoustic properties of the sea bed were estimated for seven locations covering off-shore, mid-depth and near-shore.

Sound speed profiles for each of the modelled sites were derived from temperature and salinity profiles from the U.S. Naval Oceanographic Office's Generalized Digital Environmental Model v3.0.

6.2 Modelled scenarios

JASCO modelled underwater noise from construction and operational sources for the Project, with results predicted for relevant operations at seven locations within the Project area. Modelling has been undertaken for four separate sound speed vs. depth profiles, representative of conditions in February, May, October and

December. Table 6-1, adopted from Tables 6 and 7 of the JASCO report, summarizes the modelled scenarios.

Table 6-1 Scenarios modelled by JASCO

Location	Project stage	Activity	Underwater Noise Sources	Months Modelled
Site 1: LNGRV transit	Operation	LNGRV transit	LNGRV movement	February, May, October, December
Site 2: Buoy 2	Operation	LNGRV mooring	LNGRV thrusters	February, May, October, December
		LNGRV weather vaning	LNGRV thrusters	
		Operational support	Operational Support Vessel	
		Regasification	LNGRV regasification equipment Support Vessel	
Site 2: Buoy 2	Construction	Suction pile installation	Heavy Lift Vessel	May, October
		Setting mooring lines, umbilical, PLEM	Suction piling (and if needed, anchor pile driving)	
			DP dive support vessel	
Site 3: Mainline offshore	Construction	Pipeline installation	DP pipelay vessel	May, October
		Pipeline lowering and backfilling	DP plow vessel	
Site 4: Mainline mid point	Construction	Pipeline installation	DP pipelay vessel	May, October
		Pipeline lowering and backfilling	DP plow vessel	
Site 5: Mainline near shore	Construction	Pipeline installation	DP pipelay vessel	May, October
		Pipeline lowering and backfilling	DP plow vessel	
Site 6: Power line cable crossing	Construction	Pipeline installation	DP pipelay vessel	May, October
		Pipeline lowering and backfilling	DP plow vessel	
Site 7: Transco Tie In	Construction	Pipeline lowering (jetting)	DP dive support vessel	May, October
		Pipeline lowering (jetting)	DP dive support vessel	

Location	Project stage	Activity	Underwater Noise Sources	Months Modelled
Sites 1-7: Various	Decommissioning, routine maintenance, and unplanned events	Would utilize similar sized operational and support vessels as above. Activities not modelled by JASCO.		Various

6.3 JASCO results

JASCO provided modelling results in the form of tabulated sound level threshold radii, measured in meters. Threshold distances are calculated from SPL (referred to as “per-pulse results”), and SELc (referred to as “cumulative SEL results”).

6.3.1 Noise metrics

SELc noise levels modelled by JASCO utilize a 24-hour accumulation time with the exception of impact piling. Impact piling uses an accumulation time corresponding to the 8,700 impacts estimated to be required to drive each pile, if in fact, the pile driving alternative is necessary at all. The piling contractor has suggested this will equate to an exposure time of approximately 2.5 hours per pile (if utilized).

NOAA’s Draft Guidance suggests a 1-hour accumulation period for SELc where animal behaviors/movements within the Project area are not known or cannot be modelled. The longer accumulation times used in modelling by JASCO will result in threshold radii that will be more conservative (i.e. larger in size) than if a 1 hour period was used.

JASCO did not report peak levels in their modelling results. In order to provide a level of objective assessment of peak levels from impact piling sources against the noise criteria, we used the relationship between dBpeak and dB_{rms} levels identified for impact piling as discussed in Appendix B. Because it is highly unlikely that impact piling will be utilized to install anchors for this Project, numbers for piling driving are reported in Appendix C for reference only.

6.3.2 Frequency weighting functions

Results are provided for unweighted M_{lf}, M_{mf}, M_{hf}, and M_{pp}, frequency weighting functions for LF cetaceans, MF cetaceans, HF cetaceans and phocid pinnipeds.

6.3.3 Sound level threshold radii

Tabulated sound level threshold radii are presented as both maximum range (R_{max}) and the 95% range ($R_{95\%}$) statistics. JASCO define $R_{95\%}$ as the radius of a circle, centered on the source, for which 95% of modelled spatial grid points have predicted sound levels at or above the given value. R_{max} is equivalent to $R_{100\%}$ as defined using the same methodology. In terms of impact on fauna, JASCO states that $R_{95\%}$ is equivalent to the range at which less than 5% of a uniformly distributed population would be exposed to sound at or above the given noise level. Because the population distribution of marine fauna (particularly cetaceans) is unlikely to be uniform throughout the Project area in time and space, this assessment uses the $R_{95\%}$ sound level thresholds. $R_{95\%}$ is less sensitive to small noise contour outliers scattered away from the main contour body, which would cause the $R_{100\%}$ sound level threshold radii to increase disproportionality to the size of the main contour body.

6.4 Construction phase results

This section summarizes the JASCO modelling results for the construction phase of the Project, in the form of threshold distances where the relevant criterion is exceeded.

Tables 6-2 and 6-3 provide the horizontal threshold distances from the underwater source location to the isopleth corresponding to criteria levels for cetaceans, sea turtles and fish for the construction phase of the Project. Tabulated results for cetaceans are direct excerpts from Section 4.3 of the JASCO report. Results for sea turtles and fish are based upon tabulated results in Appendix A of the JASCO report. Where multiple locations have been modelled we have reported the highest threshold distance from all locations.

6.5 Operation phase results

This section summarizes the JASCO modelling results for the operation phase of the Project, in the form of threshold distances where the relevant criterion is exceeded.

Tables 6-4 and Table 6-5 provide the horizontal threshold distances from the underwater source location to the isopleth corresponding to criteria levels for cetaceans, seals, sea turtles and fish for the operational phase of the Project. Results for cetaceans and seals are direct excerpts from Section 4.2 of the JASCO report. Results for sea turtles and fish are based upon tabulated results in Appendix A of the JASCO report. Where multiple locations have been modelled we have reported the highest threshold distance from all locations.

JASCO has split transit and mooring activities for per-pulse results, and combined these activities for cumulative SEL results. To assess the peak and rms levels, we have adopted the threshold distances from mooring activities, as mooring produces higher noise levels than transit activities.

Table 6-2 Summary of relevant construction phase threshold distances for Cetaceans

Activity	Month	LF Cetaceans		MF Cetaceans		HF Cetaceans	
		PTS Threshold [m]	TTS Threshold [m]	PTS Threshold [m]	TTS Threshold [m]	PTS Threshold [m]	TTS Threshold [m]
Suction piling	May	124	3,110	<20(1)	438	209	3,790
	Oct	121	2,850	<20(1)	400	194	3,610
Lateral pipeline installation	May	247	4120	168	375	193	3,140
	Oct	238	3630	168	349	191	2,920
Lateral pipeline lowering and backfilling	May	288	1,950	<20(1)	288	288	1,060
	Oct	288	1,790	<20(1)	290	288	990
Mainline installation	May	343	4,820	219	479	262	3,780
	Oct	327	4,510	219	453	260	3,580
Mainline lowering and backfilling	May	327	2,190	<20(1)	327	326	1,350
	Oct	338	2,040	<20(1)	327	326	1,260
Pipeline lowering by jetting	May	165	3,440	<20(1)	529	270	4,090
	Oct	143	3,230	<20(1)	494	253	3,890

Table 6-3 Summary of relevant construction phase threshold distances for seals, sea turtles and fish

Activity	Month	Seals		Sea Turtles		Fish	
		PTS Threshold [m]	TTS Threshold [m]	Harm Threshold [m]	Harassment Threshold [m]	Harm Threshold [m]	Harassment Threshold [m]
Suction Piling	May	157	1,660	N/A(2)	<20(1)	1,400	N/A(3)
	Oct	150	1,510		<20(1)	900	
Lateral pipeline installation	May	274	2190		<20(1)	850	
	Oct	260	1980		<20(1)	1050	
Lateral pipeline lowering and backfilling	May	288	990		<20(1)	1050	
	Oct	290	895		<20(1)	650	
Mainline installation	May	379	2590		<20(1)	1500	
	Oct	367	2440		<20(1)	1400	
Mainline lowering and backfilling	May	327	1220		<20(1)	900	
	Oct	328	1140		<20(1)	850	
Pipeline lowering by jetting	May	220	1920		<20(1)	1050	
	Oct	205	1780		<20(1)	1050	

Notes:

(1) We have assessed both SELc and dBpeak noise levels for impact piling against the NOAA criteria for Cetaceans. Levels corresponding to the relevant noise criterion are predicted to occur within threshold distances of less than 20 m according to the JASCO tabulated results.

(2) Because the harm criterion for turtles is a dBpeak criterion, and threshold distances in terms of dBpeak are not available, distances could not be calculated for the harm threshold for turtles.

(3) Because no data on behavioral shifts (harassment) in Atlantic sturgeon due to noise from similar construction activity exists, harassment distance for Atlantic sturgeon was not estimated.

Table 6-4 Summary of relevant operation phase threshold distances for cetaceans

Activity	Month	LF Cetaceans		MF Cetaceans		HF Cetaceans	
		PTS Threshold [m]	TTS Threshold [m]	PTS Threshold [m]	TTS Threshold [m]	PTS Threshold [m]	TTS Threshold [m]
LNGRV transit and mooring	Feb	270	16,300	270	ND	270	35,000
	May	270	18,800	270	ND	270	36,300
	Oct	270	22,500	270	ND	270	37,300
	Dec	270	18,700	270	ND	270	36,600
LNGRV weather vaning	Feb	244	4,550	<20(1)	384	157	3,320
	May	239	4,020	<20(1)	375	152	3,090
	Oct	228	3,540	<20(1)	344	147	2,860
	Dec	238	4,300	<20(1)	374	154	3,180
Regasification	Feb	<20(1)	729	<20(1)	705	21	776
	May	<20(1)	728	<20(1)	705	21	771
	Oct	<20(1)	725	<20(1)	705	21	758
	Dec	<20(1)	728	<20(1)	705	21	766

Notes:

(1) Levels corresponding to the relevant noise criterion are predicted to occur within threshold distances of less than 20 m according to the JASCO tabulated results.

(2) ND=No accurate data for MF cetaceans available for TTS.

Table 6-5 Summary of relevant operation phase threshold distances for seals, sea turtles and fish

Activity	Month	Seals		Sea Turtles		Fish	
		PTS Threshold [m]	TTS Threshold [m]	Harm Threshold [m]	Harassment Threshold [m]	Harm Threshold [m]	Harassment Threshold [m]
LNGRV transit and mooring	Feb	270	914	N/A(1)	240	423(2)	N/A(4)
	May	270	903		240	410(2)	
	Oct	270	779		240	385(2)	
	Dec	270	861		240	403(2)	
LNGRV weather vaning	Feb	281	2,380		<20(3)	1,800	
	May	274	2,240		<20(3)	1,700	
	Oct	251	1,990		<20(3)	1,700	
	Dec	268	2,290		<20(3)	1,800	
Regasification	Feb	<20(3)	717		<20(3)	717	
	May	<20(3)	717		<20(3)	717	
	Oct	<20(3)	717		<20(3)	717	
	Dec	<20(3)	717		<20(3)	717	

Notes:

(1) The harm criterion for turtles is a dBpeak criterion. Since threshold distances in terms of dBpeak have not been provided, no predictions can be made.

(2) Threshold distances were not predicted by Jasco for levels less than 190 dB SELc for fish during LNGRV transit and mooring, therefore the Harm threshold distance for the 190 dB level was used.

(3) Levels corresponding to the relevant noise criterion are predicted to occur within threshold distances of less than 20m according to the JASCO tabulated results.

(4) Because no data on behavioral shifts (harassment) in Atlantic sturgeon due to noise from similar construction activity exists, harassment distance for Atlantic sturgeon was not estimated.

7.0 Risk Analysis

Based on Neubert and Sullivan's (2014) abundance estimates we assess risk from underwater sound sources to nine protected marine mammals, four sea turtles and one fish species that could potentially transit the Project area on a seasonal basis as described in Section 4 (Tables 4-3 and 4-4).

As described in Section 5 of this report, each of these species can be grouped into hearing categories as defined by NOAA (2014):

- LF cetaceans (North Atlantic right whales, humpback whales, and fin whales);
- MF cetaceans (bottlenose dolphins and common dolphins);
- HF cetaceans (harbor porpoises);
- Phocid pinnipeds (harbor seals, harp seals and gray seals);
- Sea Turtles (loggerhead, Kemp's ridley, green, and leatherback sea turtles); and
- Fish (Atlantic sturgeon).

Using the risk framework described below we assess risk to each of these groups for each of the Project activities that will generate underwater sound. Based on the distances for PTS (Harm) and TTS (Harassment) as defined by NOAA we rank each Project activity with respect to groups of species that could potentially transit the Project area.

7.1 Risk analysis framework

The risk level is determined by first selecting the appropriate consequence and likelihood descriptors from the definitions included in Table 7-1 and Table 7-2.

Consequence levels reflect the impact that exposure to underwater sound from the Project would have on a species. In determining the consequence level we have considered the sources of sound from each Project activity relative to existing noise levels in the environment (as discussed in Section 2).

Table 7-1 Risk analysis framework consequence descriptors

Consequence Level to Impacted Species				
Negligible	**Minor**	**Moderate**	**Major**	**Extreme**
Minimal impact in a localized area of little or no consequence to the species.	Low impact in a localized or regional area with a functional recovery within one year.	Medium impact in a localized or regional area with a functional recovery of 1 to 5 years.	High impact in a localized or regional area with a functional recovery within 5 to 10 years.	Very high impact in a regional area with functional recovery in greater than 10 years, if at all.

Likelihood levels consider how probable it is for members of a functional hearing group or species to be impacted by exposure to noise from an activity associated with the Project. To determine likelihood we considered the following: the temporary and spatially explicit nature of the construction phase of the Project; the transient and seasonal nature of the species moving through the Project area, and the ability of animals to move away from potential sound sources.

Table 7-2 Risk analysis framework likelihood levels

Likelihood of Impact to Individual or Species from Sound Source				
Rare	**Unlikely**	**Likely**	**Almost certain**	**Certain**
Highly unlikely to occur but theoretically possible.	May occur within the life of the Project or activity.	Likely to occur more than once during the life of the Project or activity.	Very likely to occur during the life of the Project or activity.	Will occur as a result of the Project or activity.

Risk is then determined by identifying the matching risk row and consequence column of the risk matrix shown below in Table 7-3, with the risk level given by the matrix cell which the risk row and consequence column intersect at.

Table 7-3 Risk assessment matrix

Likelihood	Consequence				
	Negligible	**Minor**	**Moderate**	**Major**	**Extreme**
Rare	Low	Low	Low	Medium	High
Unlikely	Low	Low	Medium	Medium	High
Likely	Low	Medium	Medium	High	High
Almost certain	Medium	Medium	High	High	Critical
Certain	Medium	Medium	High	Critical	Critical

7.2 Construction phase risk analysis

Because impact piling was assessed to have the highest potential for sound generation (over the widest area) associated with the proposed Project, the decision was made that the anchors will be installed at the Port using suction piles. A verification study (Moffatt and Nichol 2014) commissioned by Liberty confirmed this approach. All sound sources from the construction phase of the Project are considered to have a Minor impact to species of marine mammals, turtles and fish (See Tables 6-2 to 6-5 above and Section 4 of Jasco 2014) relative to “harm” criteria (PTS). Because impact piling is not intended to be used for anchor placement it is only mentioned in the following sections for comparison purposes. For additional details about the potential impacts from pile driving to functional hearing groups see Appendix C.

Because the behavioral response of marine mammals, sea turtles, and fishes to a perceived marine sound depends on a range of factors, including: (1) the sound pressure level (SPL); (2) frequency, duration, and novelty of the sound; (3) the physical and behavioral state of the animal at the time of perception; and (4) the ambient acoustic features of the environment (Hildebrand 2004) it is more difficult to predict behavioral shifts due to anthropogenic sounds. The radiation of sound to marine waters during the construction phase of this Project will be within the immediate vicinity of the Project and effects are expected to be temporary, hence “harassment” (TTS) for all species are ranked as Negligible to Minor.

Although species abundance varies by season in the Project area the likelihood of “harm” (PTS) or “harassment” (TTS) from the Project to individuals or species due to underwater sound is Rare to Unlikely because of the transient and seasonal nature of the species moving through the Project area, and the ability of animals to move away from sound sources.

Overall risk from underwater sound for each functional group and species is determined by identifying the matching risk row and consequence column of the risk matrix for the construction phase of the Project below.

7.2.1 LF cetaceans (whales)

As described in detail in Section 4, there are three whale species listed as endangered under the ESA that could potentially transit the Project area that are classified as LF cetaceans: fin whales (*Balaenoptera physalus*), humpback whales (*Megaptera novaeangliae*), and the North Atlantic right whale (*Eubalaena glacialis*).

All sound sources from the construction phase of the Project are considered to have Minor consequences to LF cetaceans with respect to "harm" (PTS) and Minor consequence to LF cetaceans with respect to TTS. Because North Atlantic right whales are rarely likely to occur in the Project area they are ranked as Rare in terms of Likelihood. Fin whales and humpback whales have the potential to transit the Project area for a temporary period of time, but are also Unlikely to dwell within the small areas encompassing the TTS or PTS threshold zones for the modelled period of 24 hours so are ranked as Unlikely in terms of Likelihood.

Suction piling noise levels are predicted to exceed the TTS threshold for LF cetaceans within 3.5 km of piling, and the PTS criterion within 130 m of suction piling. We consider the likelihood of TTS or PTS occurrence from suction piling to be Rare-Unlikely, as it is highly unlikely that a LF cetacean would dwell within the small areas encompassing the TTS or PTS threshold zones for the modelled period of 24 hours. The overall risk level to all three LF cetaceans from suction piling associated with the Project is Low for PTS and TTS occurrence.

Installation of the lateral pipeline will produce noise levels that are predicted to exceed the PTS criterion for LF cetaceans within 250 m. The PTS threshold distance for lowering and backfilling activities for the lateral pipeline is 300 m. The TTS setback distances are 4.2 km and 2 km respectively. We consider the likelihood of PTS or TTS occurrence for LF cetaceans from Lateral pipeline installation to be Rare-Unlikely, as it is highly unlikely that a cetacean would dwell within the given small PTS or TTS threshold zones for 24 hours, even if the construction timeframe of the pipeline sections overlaps the cetacean season. The overall risk level to all three LF cetaceans from lateral pipeline installation is Low for PTS and TTS occurrence.

Activities associated with the installation of the Mainline have threshold distances similar in magnitude to those from installation of the Lateral pipelines. The PTS criterion for LF cetaceans is exceeded within 350 m for installation and 340 m for lowering and backfilling. The TTS setback distances are 5 km and 2.2 km respectively. We consider the likelihood of LF cetaceans incurring PTS or TTS from Mainline installation to be Rare-Unlikely, as it is highly unlikely that a cetacean would dwell within the given small PTS or TTS threshold zones for 24 hours, even if the construction timeframe of the pipeline sections overlaps the LF cetacean season. The overall risk level to all three LF cetacean species from Mainline installation is Low for PTS and TTS occurrence.

Lowering of the pipeline using jetting is predicted to have similar threshold distances to suction piling. The PTS threshold distance is 170 m and the TTS threshold distance is 3.5 km. We consider the likelihood of a cetacean incurring PTS or TTS from this activity to be Rare-Unlikely, as it is highly Unlikely that a cetacean would dwell within the given small PTS or TTS threshold zones for 24 hours. The overall risk level to the three LF cetacean species from pipeline lowering using jetting is Low for PTS and TTS occurrence.

7.2.2 Mid frequency cetaceans (bottlenose and common dolphins)

Two marine mammal species protected under the MMPA, bottlenose dolphins (*Tursiops truncatus*) and common dolphins (*Delphinus delphis*) could potentially transit the Project area and are classified as MF cetaceans. All sound sources from the construction phase of the Project are considered to have Minor consequences to the two species of MF cetaceans with respect to "harm" (PTS) and Negligible consequence with respect to TTS. Because bottlenose and common dolphins have the potential to transit the Project area in low numbers in some seasons (see Table 4-3) and because of their ability to move away from sound sources, likelihood for PTS is Rare and TTS is ranked as Unlikely.

Noise levels from suction piling are predicted to exceed the TTS threshold for MF cetaceans within approximately 450 m of piling, and the PTS criterion within 20 m of suction piling. We consider the likelihood of TTS from suction piling noise to be Unlikely and PTS occurrence to be Rare; as it is improbable that a MF cetacean would dwell within the small areas encompassing the TTS or PTS threshold zones for the modelled accumulation period of 24 hours. The overall risk level to both bottlenose and common dolphins from suction piling associated with the Project is Low for PTS and TTS occurrence.

Installation of the Lateral pipeline will produce noise levels that are predicted to exceed the PTS criterion for MF cetaceans within 170 m. The PTS threshold distance for lowering and backfilling activities for the lateral pipeline is 20 m. The TTS setback distances are 380 m and 290 m, respectively. We consider the likelihood of PTS occurrence from Lateral pipeline construction to be Rare, and TTS occurrence to be Unlikely, as it is highly improbable that a cetacean would dwell within these small PTS or TTS threshold zones for 24 hours. The overall risk level to both species of MF cetaceans from Lateral pipeline installation is Low for PTS and TTS occurrence.

Activities associated with the installation of the Mainline have threshold distances similar in magnitude to those from installation of the Lateral pipelines. The PTS criterion for MF cetaceans is exceeded within 220 m for installation and 20 m for lowering and backfilling. The TTS setback distances for the same activities are 480 m and 330 m respectively. We consider the likelihood of MF cetaceans incurring PTS from Mainline installation to be Rare and TTS to be Unlikely, as it is highly improbable that a cetacean would dwell within the given PTS/TTS threshold zones for 24 hours. The overall risk level to both species of MF cetaceans that could transit the Project area from Mainline installation is Low for PTS and TTS occurrence.

Lowering of the pipeline using jetting is predicted to have similar threshold distances to suction piling. The PTS threshold distance is 20 m and the TTS threshold distance is 530 m. We consider the likelihood of a cetacean incurring PTS to be Rare and TTS to be Unlikely, as it is highly unlikely that a cetacean would dwell within the given small PTS or TTS threshold zones for 24 hours. The overall risk level to both species of MF cetaceans from pipeline lowering using jetting is Low for PTS and TTS occurrence.

7.2.3 High frequency cetaceans (harbor porpoise)

Harbor porpoises (*Phocoena phocoena*) are the only HF cetacean with the potential to transit the Project area and in low abundances (Table 4-3). All sound sources from the construction phase of the Project are considered to have Minor consequences with respect to “harm” (PTS) and Negligible consequence with respect to TTS to harbor porpoises. Because harbor porpoises could transit the Project area in low numbers in some seasons (see Table 4-3) and because of their ability to move away from sound sources, likelihood for PTS is Rare and for TTS is Unlikely.

Noise levels from suction piling are predicted to exceed the TTS threshold for harbor porpoises within 3.8 km of piling, and the PTS criterion within 210 m of suction piling. The short duration of suction piling activities during construction, and the timing of activities outside of season for HF cetaceans suggest the likelihood of TTS occurrence from suction piling noise to be Unlikely and the likelihood of PTS occurrence to be Rare. The overall risk level to harbor porpoises from suction piling associated with the Project is Low for PTS and TTS occurrence.

Installation of the Lateral pipeline will produce noise levels that are predicted to exceed the TTS criterion for HF cetaceans within 3.1 km. The TTS threshold distance for lowering and backfilling activities for the Lateral pipeline is 1.1 km. The PTS distances are 193 m and 288 m respectively. We consider the likelihood of TTS occurrence from the activities to be Unlikely and the likelihood of PTS occurrence to be Rare, as it is improbable that a harbor porpoise would dwell within these small PTS or TTS threshold zones for the entire

24 hour accumulation period. The overall risk level to harbor porpoises from lateral pipeline installation is Low for PTS and TTS occurrence.

Activities associated with the installation of the Mainline have threshold distances similar in magnitude to those from installation of the Lateral pipelines. The PTS criterion for HF cetaceans is exceeded within 270 m for installation and 330 m for backfilling and lowering. The TTS setback distances for the same activities are 3.8 km and 1.4 km respectively. We consider the likelihood of TTS occurrence from the activities associated with installation of the Mainline to be Unlikely and the likelihood of PTS occurrence to be Rare. The overall risk level to harbor porpoises from Mainline installation is Low for PTS and TTS occurrence.

Lowering of the pipeline using jetting is predicted to have similar magnitude of threshold distances to suction piling. The PTS threshold distance is 270 m and the TTS threshold distance is 4.1 km. We consider the likelihood of TTS occurrence from the activities associated with installation of mainline pipeline to be Unlikely and the likelihood of PTS occurrence to be Rare. The overall risk level to harbor porpoises from pipeline lowering using jetting is Low for PTS and TTS occurrence.

7.2.4 Phocid pinnipeds (seals)

Harbour seals (*Phoca vitulina*), gray seals (*Halichoerus grypus*), and harp seals (*Pagophilus groenlandicus*) are categorized as phocid pinnepids with respect to hearing categories and could transit the Project area in small numbers (Table 4-3). Species of phocid pinnipeds are only likely to transit the Project area at the beginning and/or end of the construction phase because they are typically present in the New York Bight area in autumn, winter and spring (Table 4-4). All sound sources from the construction phase of the Project are considered to have Minor consequences with respect to “harm” (PTS) and Minor consequence with respect to TTS for seals. Because the three species of seals could transit the Project area in low numbers in some seasons (see Table 4-3) and because of their ability to move away from sound sources, likelihood for PTS is Rare and for TTS is Unlikely.

Suction piling noise levels are predicted to exceed the TTS threshold for seals within 1.7 km of piling, and the PTS criterion within 160 m of suction piling. We consider the likelihood for PTS is Rare and for TTS is Unlikely, as it is highly Unlikely that a phocid pinniped would dwell within the small areas encompassing the TTS or PTS threshold zones for the modelled accumulation period of 24 hours outside of season. The overall risk level to seals from suction piling associated with the Project is Low for PTS and TTS occurrence.

Installation of the Lateral pipeline will produce noise levels that are predicted to exceed the PTS criterion for seals within 280 m. The PTS threshold distance for lowering and backfilling activities for the Lateral pipeline is 290 m. The TTS setback distances are 2.1 km and 1 km respectively. We consider the likelihood of PTS occurrence for seals from Lateral pipeline installation to be Rare and for TTS to be Unlikely, as it is highly Unlikely that a pinniped would dwell within the given small PTS or TTS threshold zones for 24 hours, even if the construction timeframe of the pipeline sections overlapped the phocid pinniped season. The overall risk level to seals from Lateral pipeline installation is Low for PTS and TTS occurrence.

Activities associated with the installation of the Mainline have threshold distances similar in magnitude to those from installation of the Lateral pipelines. The PTS criterion for seals is exceeded within 380 m for installation and 330 m for lowering and backfilling. The TTS setback distances are 2.6 km and 1.3 km respectively. We consider the likelihood of seals incurring PTS from Mainline installation to be Rare and for TTS to be Unlikely, as it is highly Unlikely that a pinniped would dwell within the predicted small PTS or TTS threshold zones for 24 hours, even if the construction timeframe of the pipeline sections overlaps the phocid pinniped season. The overall risk level to the three seal species from Mainline installation is Low for PTS and TTS occurrence.

Lowering of the pipeline using jetting is predicted to have similar threshold distances to suction piling. The PTS threshold distance is 220 m and the TTS threshold distance is 2.0 km. We consider the likelihood of a pinniped incurring PTS from this activity to be Rare and TTS to be Unlikely, as it is highly unlikely that a pinniped would dwell within the predicted small PTS or TTS threshold zones for 24 hours. The overall risk level to all three seals from pipeline lowering using jetting is Low for PTS and TTS occurrence.

Table 7-4 summarizes risk ratings for construction phase activities for marine mammals.

Table 7-4 Risk analysis – construction phase, marine mammals

Functional Hearing Group	Item	Consequence		Likelihood		Risk	
		TTS	**PTS**	**TTS**	**PTS**	**TTS**	**PTS**
LF Cetaceans (humpback, fin and North Atlantic right whales)	Suction piling	Minor	Minor	Rare	Rare	Low	Low
	Lateral pipeline installation	Minor	Minor	Rare	Rare	Low	Low
	Lateral pipeline lowering and backfilling	Minor	Minor	Rare	Rare	Low	Low
	Mainline installation	Minor	Minor	Rare	Rare	Low	Low
	Mainline lowering and backfilling	Minor	Minor	Rare	Rare	Low	Low
	Pipeline lowering by jetting	Minor	Minor	Rare	Rare	Low	Low
MF Cetaceans (bottlenose and common dolphins)	Suction piling	Negligible	Minor	Unlikely	Rare	Low	Low
	Lateral pipeline installation	Negligible	Minor	Unlikely	Rare	Low	Low
	Lateral pipeline lowering and backfilling	Negligible	Minor	Unlikely	Rare	Low	Low
	Mainline installation	Negligible	Minor	Unlikely	Rare	Low	Low
	Mainline lowering and backfilling	Negligible	Minor	Unlikely	Rare	Low	Low
	Pipeline lowering by jetting	Negligible	Minor	Unlikely	Rare	Low	Low
HF cetaceans (Harbor porpoises)	Suction piling	Negligible	Minor	Unlikely	Rare	Low	Low
	Lateral pipeline installation	Negligible	Minor	Unlikely	Rare	Low	Low
	Lateral pipeline lowering and backfilling	Negligible	Minor	Unlikely	Rare	Low	Low
	Mainline installation	Negligible	Minor	Unlikely	Rare	Low	Low
	Mainline lowering and backfilling	Negligible	Minor	Unlikely	Rare	Low	Low
	Pipeline lowering by jetting	Negligible	Minor	Unlikely	Rare	Low	Low
Phocid Pinnipeds (seals)	Suction piling	Negligible	Minor	Unlikely	Rare	Low	Low
	Lateral pipeline installation	Negligible	Minor	Unlikely	Rare	Low	Low
	Lateral pipeline lowering and backfilling	Negligible	Minor	Unlikely	Rare	Low	Low
	Mainline installation	Negligible	Minor	Unlikely	Rare	Low	Low
	Mainline lowering and backfilling	Negligible	Minor	Unlikely	Rare	Low	Low
	Pipeline lowering by jetting	Negligible	Minor	Unlikely	Rare	Low	Low

7.2.5 Sea turtles

Four species of sea turtles, including loggerheads (*Caretta caretta*), Kemp's ridley sea turtles (*Lepidochelys kempi*), green sea turtles (*Chelonia mydas*), and leatherbacks (*Dermochelys coriacea*) could also potentially transit the Project area in summer (Table 4-3 and 4-4). The radiation of sound to marine waters from construction will be within the immediate vicinity of the Project and is expected to be temporary; therefore all sound sources from the construction phase of the Project are considered to have a Minor impact to all four species of sea turtles relative to harm and harassment criteria.

The likelihood of harassment from the Project to sea turtles is considered Rare because construction activities have been predicted based on a 24 hour cumulative SEL exposure. As it is highly unlikely that a sea turtle would inhabit the area within the Harassment threshold distance for an entire 24 hour period, we consider the likelihood level for harassment to be Rare.

Suction piling underwater noise levels are predicted to be in excess of the Harassment criterion for sea turtles within 20 m of the Heavy Lift Vessel noise source. Because suction piling levels have been predicted based upon a 24 hour cumulative SEL exposure and it is highly unlikely that an animal would inhabit the 20 m area within the Harassment threshold distance for an entire 24 hour period, we consider the likelihood level for harassment to be Rare. The overall risk level for Harassment to all four species of sea turtles from suction piling is Low.

Installation of the Lateral pipelines, Mainline pipeline, lowering and backfilling activities, and jetting will also produce sound levels that are predicted to exceed the Harassment criterion for turtles within a 20 m radius of construction activities. The overall risk level to loggerhead, leatherback, Kemp's ridley and green turtles due to Project construction activities is Low.

Table 7-5 summarizes risk ratings for construction phase activities for sea turtles.

Table 7-5 Risk analysis – construction phase, sea turtles

	Activity Relative to Harassment Criteria	**Consequence**	**Likelihood**	**Risk**
Sea Turtles (leatherback, loggerhead, green and Kemp's ridley sea turtles)	Suction piling	Minor	Rare	Low
	Lateral pipeline installation	Minor	Rare	Low
	Lateral pipeline lowering and backfilling	Minor	Rare	Low
	Mainline installation	Minor	Rare	Low
	Mainline lowering and backfilling	Minor	Rare	Low
	Pipeline lowering by jetting	Minor	Rare	Low

7.2.6 Fish (Atlantic Sturgeon)

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) is the only fish species known to be present in the waters of the NY Bight year-round with five DPSs listed as endangered or threatened under the ESA. Elevated underwater noise levels from the Project are anticipated to have a minor consequence where the Harm criterion is exceeded. Because no data on behavioral shifts in Atlantic sturgeon due to noise from similar construction activity exists, harassment distances for Atlantic sturgeon are not estimated in this report.

Suction piling underwater noise levels are predicted to exceed the Harm criterion within 1.4 km of the suction piling source for fish. Suction piling harm threshold distances have been predicted based upon a 24 hour cumulative exposure. We consider it improbable that Atlantic sturgeon would inhabit the area within the threshold distances for an entire 24 hour period without changing behavior to avoid the noise. As such we consider the likelihood level for suction piling to be Unlikely and the consequences to the species to be Minor. The risk level to Atlantic Sturgeon from suction piling is Low.

Installation of the Lateral pipeline will produce noise levels that are predicted to exceed the Harm criterion within 1.5 km of the source. For lowering and backfilling activities, the Harm threshold is within 700 m. The installation of the Mainline is predicted to have threshold distances of 1.5 km and lowering and backfilling activities have a Harm threshold distance of 1 km. Lowering of the pipeline using jetting is predicted to have a Harm threshold distance of 1.1 km. These are similar threshold distances to suction piling, and we consider the likelihood level to be Unlikely and the consequences to the species to be Minor. The overall risk level to Atlantic Sturgeon from Project construction activities is Low.

Table 7-6 summarizes risk ratings for construction phase activities for Fish.

Table 7-6 Risk analysis – construction phase, fish

	Activity Relative to Harm Criteria	Consequence	Likelihood	Risk
Atlantic Sturgeon	Suction piling	Minor	Unlikely	Low
	Lateral pipeline installation	Minor	Unlikely	Low
	Lateral pipeline lowering and backfilling	Minor	Unlikely	Low
	Mainline installation	Minor	Unlikely	Low
	Mainline lowering and backfilling	Minor	Unlikely	Low
	Pipeline lowering by jetting	Minor	Unlikely	Low

7.3 Operation phase risk analysis

All sound sources from the operational phase of the Project are considered to have a Negligible to Minor consequences to species of marine mammals, turtles and fish (See Tables 6-2 to 6-5 above and Section 4 of Jasco 2014) relative to harm criteria (PTS). The radiation of sound to marine waters during operations is expected to be temporary, hence “harassment” (TTS) for all species are also ranked as Negligible to Minor.

Although species abundance varies by season and species in the Project area the likelihood of “harm” (PTS) or “harassment” (TTS) from the Project to individuals or species due to underwater sound is Rare to Unlikely because of the transient and seasonal nature of the species moving through the Project area, and the ability of animals to move away from sound sources.

Overall risk from underwater sound during operations for each functional group and species is determined by identifying the matching risk row and consequence column of the risk matrix.

7.3.1 Low frequency cetaceans (whales)

Noise levels predicted for LNGRV transit and mooring activities show the TTS criterion to be exceeded for LF cetaceans within 23 km of the source, and PTS threshold to be exceeded for LF cetaceans within 270 m. The total time for transit and mooring activities to occur was modelled as 21 hours (i.e. 20 hours to transit, and 1 hour for mooring activities). Given the steady state nature of the thruster noise source, the transient nature of ESA listed whales in the area and the ability of animals to move away from the sound source, it is considered unlikely that a cetacean would stay within the TTS or PTS threshold distance for the entire accumulation time of 21 hours, and as such we consider the Likelihood of LNGRV transit causing TTS or PTS in LF cetaceans to be Rare. The overall risk level to cetaceans (including fin whales, humpback whales and North Atlantic right whales) for LNGRV transit and mooring is Low for both PTS and TTS occurrence.

LNGRV weather vaning noise is predicted to exceed the TTS criterion for LF cetaceans within 4.5 km of the vessel. The PTS criterion is predicted to be exceeded within 250 m. These threshold distances correspond to an accumulation time of 24 hours. We note that it is likely for the LNGRV to use thrusters to weather vane while moored; however, we consider it unlikely that a LF cetacean will be within the PTS or TTS threshold distances from the LNGRV for this accumulation time. We believe that the likelihood of a fin whale, humpback whale or North Atlantic right whale suffering PTS or TTS from LNGRV weather vaning to be Rare. Therefore, the overall risk level for PTS or TTS occurring for these LF cetaceans from LNGRV weather vaning is Low.

Regasification activities are predicted to exceed the TTS criterion within a threshold distance 750 m of the LNGRV and support vessel. The PTS criterion threshold is given as less than 20 meters. We consider it unlikely that a LF cetacean will be within the threshold distances for the modelled 24 hours accumulation time. We believe the likelihood of a LF cetacean suffering TTS or PTS to be Rare. The overall risk level for TTS and PTS is Low.

7.3.2 Mid frequency cetaceans (bottlenose and common dolphins)

Noise levels predicted for LNGRV transit and mooring activities show the PTS threshold to be exceeded for MF cetaceans within 270 m. Because this threshold distance is modelled for 24 hours of continuous exposure, we consider the Likelihood of LNGRV transit causing TTS or PTS in bottlenose or common dolphins to be Rare. The overall risk level to bottlenose or common dolphins for LNGRV transit and mooring is Low for PTS occurrence and Low for TTS occurrence.

LNGRV weather vaning noise is predicted to exceed the TTS criterion for MF cetaceans within 390 m of the vessel. The PTS criterion is predicted to be exceeded within 20 m. As these threshold distances are for 24 hours of continuous exposure, we suggest that the likelihood of bottlenose or common dolphins suffering PTS or TTS from LNGRV weather vaning to be Rare. Therefore, the overall risk level for PTS or TTS occurring for bottlenose or common dolphins from LNGRV weather vaning is Low.

Regasification activities are predicted to exceed the TTS criterion within a threshold distance 705 m of the LNGRV and Support Vessel. The PTS criterion threshold is given as less than 20 meters. As these threshold distances are for 24 hours of continuous exposure, we suggest the likelihood of bottlenose or common dolphins suffering TTS or PTS to be Rare. The overall risk level for TTS and PTS for this species is Low.

7.3.3 High frequency cetaceans (harbor porpoises)

Noise levels predicted for LNGRV transit and mooring activities show the TTS criterion to be exceeded for HF cetaceans (harbor porpoises) within 38 km of the source, and PTS threshold to be exceeded for HF cetaceans within 270 m. As these threshold distances are for 24 hours of continuous exposure, we consider the Likelihood of LNGRV transit causing TTS or PTS in harbor porpoises to be Rare. The overall risk level to harbor porpoises for LNGRV transit and mooring is Low for PTS and TTS occurrence.

LNGRV weather vaning noise is predicted to exceed the TTS criterion for HF cetaceans within 3.4 km of the vessel. The PTS criterion is predicted to be exceeded within 160 m. As these threshold distances are for 24 hours of continuous exposure, we suggest that the likelihood of a harbor porpoise suffering PTS or TTS from LNGRV weather vaning to be Rare. Therefore, the overall risk level for PTS or TTS occurring for harbor porpoises from LNGRV weather vaning is Low.

Regasification activities are predicted to exceed the TTS criterion within a threshold distance of 780 m of the LNGRV and Support Vessel. The PTS criterion threshold is given as 21 m. As these threshold distances are for 24 hours of continuous exposure, we suggest the likelihood of harbor porpoises suffering TTS or PTS to be Rare. The overall risk level for TTS and PTS is Low.

7.3.4 Phocid pinnipeds (seals)

Noise levels predicted for LNGRV transit and mooring activities show the TTS criterion to be exceeded for seals within 920 m of the source, and PTS threshold to be exceeded for seals within 270 m. LNGRV weather vaning noise is predicted to exceed the TTS criterion for seals within 2.4 km of the vessel and the PTS criterion is predicted to be exceeded within 290 m. Regasification activities are predicted to exceed the TTS criterion within a threshold distance of 720 m of the LNGRV and Support Vessel. As these threshold distances are for 24 hours of continuous exposure, we suggest that the likelihood of seals suffering PTS or TTS from LNGRV transit, mooring or weather vaning or from regasification to be Rare. Therefore, the overall risk level for PTS or TTS occurring for seals from LNGRV transit, mooring or weather vaning or regasification is Low.

The PTS criterion threshold is given as 20 meters. As these threshold distances are for 24 hours of continuous exposure, we suggest the likelihood of seals suffering TTS or PTS to be Rare. The overall risk level for TTS and PTS is Low.

Table 7-7 summarizes risk ratings for Operation phase activities for marine mammals.

Table 7-7 Risk analysis – operation phase, marine mammals

Functional Hearing Group	Activity	Consequence		Likelihood		Risk	
		TTS	PTS	TTS	PTS	TTS	PTS
LF Cetaceans (Humpback, Fin and North Atlantic Right Whales)	LNGRV transit and mooring	Minor	Minor	Rare	Rare	Low	Low
	LNGRV weather vaning	Minor	Minor	Rare	Rare	Low	Low
	Regasification	Minor	Minor	Rare	Rare	Low	Low
MF Cetaceans (Bottlenose and Common Dolphins)	LNGRV transit and mooring	Negligible	Minor	Rare	Rare	Low	Low
	LNGRV weather vaning	Negligible	Minor	Rare	Rare	Low	Low
	Regasification	Negligible	Minor	Rare	Rare	Low	Low
HF cetaceans (Harbor Porpoises)	LNGRV transit and mooring	Negligible	Minor	Rare	Rare	Low	Low
	LNGRV weather vaning	Negligible	Minor	Rare	Rare	Low	Low
	Regasification	Negligible	Minor	Rare	Rare	Low	Low
Phocid Pinnipeds (xeals)	LNGRV transit and mooring	Negligible	Minor	Rare	Rare	Low	Low
	LNGRV weather vaning	Negligible	Minor	Rare	Rare	Low	Low
	Regasification	Negligible	Minor	Rare	Rare	Low	Low

7.3.5 Sea turtles

Underwater noise levels for LNGRV transit and mooring are predicted to exceed the Harassment criterion for turtles within a threshold distance of 240 m. Similar to cetaceans, it is considered unlikely that a turtle would stay within the threshold distance for Harassment without changing behavior to avoid noise. As such, we consider the Likelihood of LNGRV transit noise causing Harassment to listed species of sea turtles to be Rare. The risk level to turtles for Harm from LNGRV mooring is Low.

Weather vaning of the LNGRV is predicted to produce noise levels which will exceed the Harassment criterion for turtles within a threshold distance of less than 20 m for an accumulation time of 24 hours. We consider the Likelihood of LNGRV weather vaning noise causing Harassment to listed species of sea turtles to be Rare, and the risk level for Harassment is therefore Low.

Regasification activities are predicted to exceed the Harassment criterion within a threshold distance 750 m of the LNGRV and Support Vessel for an accumulation time of 24 hours. We consider the Likelihood of LNGRV transit noise causing Harassment to listed species of sea turtles to be Rare, and the Risk level for Harassment to be Low.

Table 7-8 summarizes risk ratings for Operation phase activities for Turtles.

Table 7-8 Risk analysis – operation phase, sea turtles

Sea Turtles (leatherback, loggerhead, green and Kemp's ridley sea turtles)	**Activity Relative to Harassment Criteria**	**Consequence**	**Likelihood**	**Risk**
	LNGRV transit and mooring	Minor	Rare	Low
	LNGRV weather vaning	Minor	Rare	Low
	Regasification	Minor	Rare	Low

7.3.6 Fish (Atlantic sturgeon)

Predictions of noise from LNGRV transit and mooring show the Harm criterion for fish to be exceeded within a threshold distance of 450 m. Similar to cetaceans and sea turtles it is considered unlikely that fish would stay within the threshold distance for Harm without changing behavior to avoid noise from the LNGRV. As such, we consider the Likelihood of LNGRV transit affecting Atlantic Sturgeon to be Unlikely. The overall risk level to Atlantic Sturgeon from LNGRV transit and mooring is Low for Harassment and Harm.

Weather vaning of the LNGRV is predicted to produce sound levels which will exceed the harm criteria for fish within a threshold distance of 1.8 km. Regasification activities are predicted to exceed the harm criterion for fish within a threshold distance of 750 m. It is considered unlikely that Atlantic Sturgeon would stay within the area of the LNGRV for an accumulation time of 24 hours, hence we consider the Likelihood of LNGRV weather vaning causing Harm to Atlantic Sturgeon to be Unlikely. The overall risk level to Atlantic Sturgeon from LNGRV weather vaning is Low.

We consider the Likelihood of regasification causing Harassment or Harm to Atlantic Sturgeon to be Rare. The overall risk level to Atlantic Sturgeon from regasification is Low for Harassment and Harm.

Table 7-9 summarizes the risk ratings for Port operation activities for Atlantic Sturgeon.

Table 7-9 Risk analysis – operation phase, fish

Atlantic Sturgeon	**Activity Relative to Harm Criteria**	**Consequence**	**Likelihood**	**Risk**
	LNGRV transit and mooring	Minor	Unlikely	Low
	LNGRV weather vaning	Minor	Unlikely	Low
	Regasification	Minor	Unlikely	Low

8.0 Noise Mitigation Strategies

Impacts to ESA and MMPA species from the proposed Port Ambrose Deepwater Port have been minimized through site selection. During the site selection process, several alternate locations were considered and this site was chosen, in large part, in order to minimize impacts to the environment.

Because impact piling was assessed to have the highest potential for sound generation associated with the proposed Project, a technical feasibility study was conducted and it was determined that suction pilling was a viable alternative to impact piling (Moffatt and Nichol 2014). Although underwater sound measurements of suction pile installations are not available, it is expected that the noise from this method of anchor placement will be negligible relative to existing sounds because the only noise source associated with suction piling is the suction pump (Spence et al. 2007). Since all impulsive type sounds are removed using this approach (CSA Ocean Sciences Inc. 2014), the impact of this activity is considered to be of little or no consequence to protected species transiting the NY Bight.

In addition, operational and behavioral mitigation measures are proposed to further reduce any risk of harm or harassment to protected marine species (Table 8-1). An appropriate combination of these noise mitigation strategies could be adopted as part of a reasonable and prudent approach to minimizing any takes of protected species from the Project. These mitigation measures and other best management practices will ensure that impacts to marine species will be avoided and minimized to the greatest extent practicable (Table 8-1).

Construction activities are identified to have a low risk of causing harm or harassment to marine fauna. Operators will however remain observant for the presence of any marine fauna in the vicinity of these construction activities. If marine fauna suspected to be either an ESA listed species or MMPA protected species are observed in the vicinity of works, construction may need to be put on temporary hold while the marine fauna within the Project area is identified and appropriate action is taken to prevent harassment or harm. In addition, protected species observers (PSOs) and awareness training for construction crews and vessel operators will be implemented.

Operational activities have a low risk of causing harassment or harm to ESA listed species. Noise from LNGRV and Support Vessel movements at Port Ambrose will be of similar magnitude and character to other shipping movements within the New York Bight, and as such the Project vessels should be treated like other vessels in the region without imposing any additional operational modifications beyond what are required on similar shipping vessels. We note that a Seasonal Management Area (SMA) is designated within 20 nautical miles of the entrance to the Port of New York and New Jersey between November 1 and April 30. Vessels over 19.8 m in overall length are restricted to 10 knots during this time for the purpose of protecting whale migratory routes. Any vessels that are associated with the Project (including LNGRVs and support vessels) that enter the SMA will adhere to this regulation.

Table 8-1 Noise mitigation strategies for construction and operational activities

Type of Mitigation	Mitigation Measure	Details
Operational	Use of alternative piling methods	Use of low sound producing piling technique (suction piling).
	Controlled timing of construction program to avoid sound exposure	Construction activities will be scheduled to occur for the minimum practical total duration to reduce the likelihood that protected species will be exposed to noise from construction activities.
	Vessel speed restrictions	• Construction vessels will comply with requirements for vessel strike avoidance. When whales are sighted, a separation distance of 100 yards or greater between the whale and vessels will be maintained (NOAA 2008). When sea turtles or small cetaceans are sighted, an attempt will be made to maintain a distance of 50 yards or greater between the animal and vessels, whenever possible (NOAA 2008). When small cetaceans are sighted while a vessel is underway (e.g., bow-riding), an attempt to remain parallel to the animal's course will be made until the cetacean has left the area. • The required separation distance for North Atlantic right whales of 500 yards (460 m) or greater, in order to reduce disturbance and collision risks, will be followed as per 50 CFR 224.103 (62 FR 6729 and 73 FR 60173). • A Seasonal Management Area (SMA) is designated within 20 nautical miles of the entrance to the Port of New York and New Jersey between November 1 and April 30. • In order to comply with the Right Whale Ship Strike Reduction Rule (50 CFR 224.105), all vessels over 19.8 m in overall length are to be restricted to 10 knots. Vessel speeds during construction activities are slow (less than 10 knots). When vessels are transiting to and from the Project area, speeds of 10 knots or less will be maintained when mother/calf pairs, groups, or large assemblages of cetaceans are observed near an underway vessel, when safety permits (NOAA 2008). The vessels will attempt to route around the animals, maintaining a minimum distance of 100 yards whenever possible. If vessels transit the North Atlantic Right Whale SMA, 10 knot speeds will also be maintained. • In order to avoid vessel strikes during transit and operations, the Early Warning System, Sighting Advisory System, and Mandatory Ship Reporting System notifying mariners of right whale presence will be monitored. • Vessel crews will report sightings of any injured or dead protected species immediately, regardless of whether the injury or death is caused by the Project's vessels. Marine mammals will be reported to the U.S. Stranding Hotline and sea turtles will be reported to NOAA Fisheries Regional Offices. Any injured, dead, or entangled right whales will be immediately reported to the U.S. Coast Guard via VHF Channel 16.

Type of Mitigation	Mitigation Measure	Details
Behavioral	PSOs	• Dedicated personnel will be assigned as PSOs during construction activities. • Safety zones typically include observation and exclusion zones. Exclusion and observation zones for marine mammals and turtles will be determined in consultation with NOAA. In the observation zone, the movement of marine species should be monitored to determine whether they are approaching or entering the exclusion zone. • PSOs operate at all times during daylight hours (dawn to dusk – i.e., from about 30 minutes before sunrise to 30 minutes after sunset) when construction activities are being conducted, unless conditions (fog, rain, darkness) make sea surface observations impossible. If conditions deteriorate during daylight hours such that the sea surface observations are halted, visual observations will resume as soon as conditions permit. • If a marine mammal or sea turtle is observed within the safety zones (as outlined above) the observer will call for the shutdown of the construction operation. The vessel operator will comply with such a call by an on-watch visual observer. Start-up of the construction equipment will continue only after it is determined that a marine mammal or sea turtle has left the safety zone or has not been sighted for 30 minutes.

9.0 Conclusion

An underwater noise impact assessment associated with construction and operation of the proposed Port Ambrose Deepwater Port in the New York Bight has been undertaken.

This assessment was designed to identify, interpret, predict and communicate information concerning potential impacts of underwater sound to protected species. Once identified, these potential impacts were assessed to define the potential risk to species, so where necessary, such risks could be removed or reduced through design, site selection, construction methods or the adoption of reasonable and effective mitigation measures.

The greatest risk of underwater sound to protected species was assessed to be the use of driven pilings as a mooring anchoring system. This source of underwater noise was removed from the project scope and was replaced with the alternative, suction piling.

All other sound sources from the construction and operations phase of the Project are considered to have a Minor impact to species of marine mammals, turtles and fish relative to the “harm” criteria (PTS). The radiation of sound to marine waters during the construction and operations phase of this Project will be within the immediate vicinity of the Project; hence “harassment” (TTS) for all species was ranked as Negligible to Minor. Underwater sound generated from routine maintenance, decommissioning and unplanned events will be similar to those from the construction and operations phase of the Project and as such were not modeled as unique sound sources. Because these activities utilize similar equipment with similar sound sources they are also considered to be Negligible to Minor for marine mammals, sea turtles and protected fish species transiting the project area.

Although species abundance varies by season the likelihood of “harm” (PTS) or “harassment” (TTS) from the Project to individuals or species due to underwater sound is Rare to Unlikely because of the localized and temporary nature of Project construction; transient and seasonal nature of the species moving through the Project area, and the ability of animals to move away from sound sources.

Using the above criteria, the overall risk from underwater sound to protected marine mammals, sea turtles and fish from construction and operational activities of the Project are predicted to have a **low level of risk to all marine fauna**.

In addition, mitigation measures are proposed to further reduce any risk of harm or harassment to protected marine species from underwater sound generated from Project activities.

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Appendix A: NOAA NMFS letter to MARAD and USCG

Appendix A NOAA NMFS letter to MARAD & USCG

DEPARTMENT OF TRANSPORTATION
FLEET OPERATIONS
2013 AUG 21 P 2:10

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

AUG 12 2013

Tracey L. Ford, Acting Director
Office of Deepwater Ports and
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Maritime Administration
1200 New Jersey Avenue SE, W23-323 (MAR-530)
Washington, DC 20590

C.E. Borland, Acting Chief
Deepwater Ports Standards Division
United States Coast Guard
2100 Second Street, SW
Washington, DC 20593-0001

Re: Liberty Natural Gas, LLC Deepwater Port (USCG-2013-0363)

Dear Mr. Borland and Ms. Ford,

This is in response to your letter dated August 8, 2013, regarding Liberty Natural Gas, LLC's, proposal to own, construct, and operate a deepwater port (Port Ambrose) in the Atlantic Ocean, approximately 17 nautical miles southeast of Jones Beach, New York; approximately 24 nautical miles east of Long Branch, New Jersey; and approximately 27 nautical miles from the entrance to New York Harbor. You have requested information on the presence of species listed by NOAA's National Marine Fisheries Service (NMFS) in the project area.

The following Endangered Species Act (ESA) listed species under NOAA's NMFS are likely to occur in the proposed project area:

Species	***Status***
Gulf of Maine Distinct Population Segment (DPS) of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)	Threatened
New York Bight DPS of Atlantic sturgeon	Endangered
Chesapeake Bay DPS of Atlantic sturgeon	Endangered
Carolina DPS of Atlantic sturgeon	Endangered
South Atlantic DPS of Atlantic sturgeon	Endangered
Northwest Atlantic Ocean DPS of loggerhead sea turtle (*Caretta caretta*)	Threatened
Kemp's ridley sea turtle (*Lepidochelys kempi*)	Endangered
Green sea turtle (*Chelonia mydas*)	Endangered

North Atlantic Right Whales (*Eubalaena glacialis*)	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered
Fin whale (*Balaenoptera physalus*)	Endangered

Listed species of Atlantic sturgeon may be present in the project area year round, while listed species of sea turtles are known to be present in the waters of New York and New Jersey from May through November, with the highest concentration of sea turtles present from June to October. The federally endangered North Atlantic right, humpback, and fin whales, are seasonally present in the waters off New York and New Jersey. These species of whales use the nearshore, coastal waters of the Atlantic Ocean as a migration route to and from calving and foraging grounds. Humpback and fin whales primarily occur in the waters of New York and New Jersey during the spring, summer and fall months, while the North Atlantic right whale primarily occur in these waters from November 1 through April 30, although transient right whales can be present outside of this time frame. Additionally, during the November 1 through April 30 timeframe, a seasonal management area (SMA) has been designated for North Atlantic right whales within a 20-nautical mile radius (as measured seaward from the COLREGS lines) of the entrance to the Ports of New York and New Jersey (located at 40°29'42.2"N and 073°55'57.6"W). Vessels 65 feet or greater in overall length transiting through the SMA at this time are restricted to 10 knots or less to protect right whales in their migratory routes.[1] As the proposed project will cross waters of the SMA, please be aware of these regulations should your proposed project occur during the months of November 1 through April 30.

Conclusion

As listed species are likely to be present in the action area of this project, a consultation, pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, may be necessary. As you may know, any discretionary federal action, such as the approval or funding of a project by a Federal agency, that may affect a listed species must undergo consultation pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended. If the proposed project has the potential to affect listed species and it is being approved, permitted or funded by a Federal agency, the lead Federal agency, or their designated non-Federal representative, is responsible for determining whether the proposed action is likely to affect this species. The Federal agency would submit their determination along with justification for their determination and a request for concurrence, to the attention of the Endangered Species Coordinator, NMFS Northeast Regional Office, Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930. After reviewing this information, NMFS would then be able to conduct a consultation under Section 7 of the

[1] For more information on this SMA, see
http://www.nmfs.noaa.gov/pr/pdfs/shipstrike/compliance_guide.pdf

ESA. Should you have any questions about these comments or about the Section 7 consultation process in general, please contact Danielle Palmer (978-282-8468; Danielle.Palmer@noaa.gov).

Sincerely,

Mark Murray-Brown

for Mary A. Colligan
Assistant Regional Administrator
for Protected Resources

EC: Palmer, NMFS/PRD
Rusanowsky, Boelke NMFS/HCD

File Code: Sec 7 technical assistance 2013– Port Ambrose LNG

Appendix B: Impact Piling: Relationship Between Noise Metrics

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Where modelling results are not reported using a particular noise metric it is possible to approximate noise metrics based upon the relationship between metrics from results of measurements of similar sound sources. Table B-1 below shows the relationship between dB_{rms} and dB_{peak} using previously collected data for piling driving.

AECOM undertook underwater noise measurements of impact piling similar to that proposed for Port Ambrose for the Adelaide Desalination project in Adelaide, South Australia in 2010. Impact piling of piles of comparable size to those proposed for Port Ambrose was undertaken in seawater in the Gulf St. Vincent at a depth of approximately 20 m. Table B-1 shows the signal recorded by the hydrophone located 2,000 m from an impact piling source, annotated with the peak and rms levels. The left graph of Figure B-1 shows the piling signal over several impacts, with the right graph showing the signal for a single impact (also shown on the left graph).

Figure B-1 Piling noise at 2,000m from Adelaide Desalination Plant impact piling

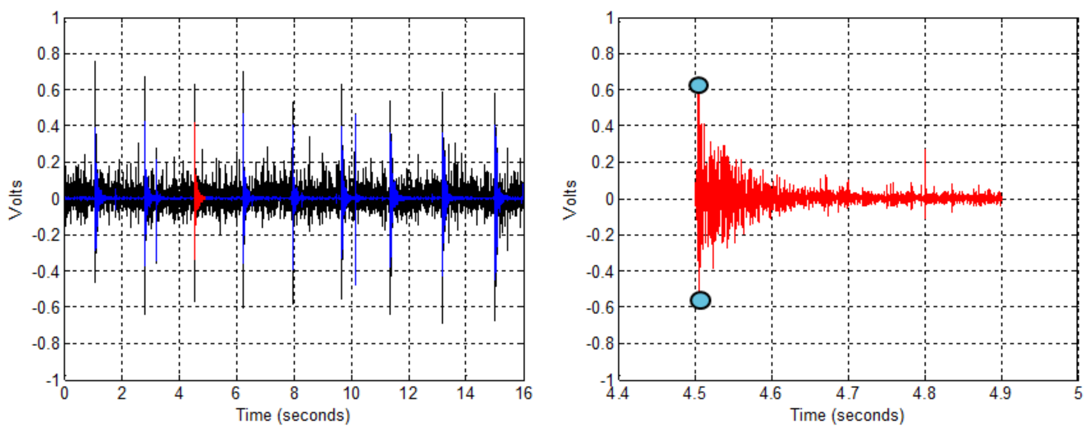

Table B-1 Noise metrics for impact piling at Adelaide Desalination Plant

Noise metric	Measured Level at 2 km from Piling	Relative Difference to Average Sound Pressure Level dB_{rms}
Average sound pressure level (dB_{rms})	141 dB re 1 μPa	N/A
Peak SPL (dB_{peak})	162 dB re 1 μPa	+21 dB
Peak-to-peak SPL	168 dB re 1 μPa	+27 dB

The measured noise metrics for impact piling and the relationship between average sound pressure level (dB_{rms}) and Peak SPL (dB_{peak}) is shown in Table B-1. For noise from impact piling sources in similar conditions (and depths), the measured values of 141 dB re 1 μPa for average sound pressure level (dB_{rms}) was measured, and the Peak SPL (dB_{peak}) was measured to be 162 dB re 1 μPa. In cases where dB_{peak} levels have not been modelled, an approximation of peak levels can therefore be made by adding a +21 dB adjustment to dB_{rms} average sound pressure levels.

Appendix C: Impact Piling Alternative

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Low frequency cetaceans and piling driving

As described in detail in Section 4, there are three whale species listed as endangered under the ESA that could potentially transit the Project area that are classified as LF cetaceans: fin whales, humpback whales, and the North Atlantic right whale.

Predicted noise levels from impact piling (if needed) suggest the TTS criterion to be exceeded for low frequency cetaceans within 65 km of the piling source, and PTS threshold to be exceeded within 13 km of piling (Table C-1). If impact piling were to occur, it is anticipated that any impacts would be limited to individuals that aretransiting the Project area while impact piling is occuring.. Considering the size of the threshold distances, the short duration of impact piling (i.e. approximately 2.5 hours of sound generation per pile) and other qualitative factors such as potential behavioural avoidance to noise and the transient nature of animals, we consider the Likelihood rating of impact piling affecting low frequency cetaceans to be Unlikely for TTS and Rare for PTS and the consequence to the species to be Minor. The overall risk level to low frequency cetaceans is therefore Low for both PTS and TTS occurrence.

Mid frequency cetaceans and pile driving

The most likely mid frequency cetaceans to occur in the vicinity of the Project are bottlenose dolphins and common dolphins, which are relatively abundant during the construction period.

Predicted noise levels from impact piling (to be used, only if needed) suggest the TTS criterion to be exceeded for mid frequency cetaceans within 9.5 km of the piling source, and PTS threshold to be exceeded within 1.2 km of piling (Table C-1). Considering the size of the threshold distances, the short duration of impact piling (i.e. approximately 2.5 hours sound generation per pile) and other qualitative factors such as potential behavioural avoidance to noise, we consider the Likelihood rating of impact piling affecting mid frequency cetaceans to be Likely for TTS and Unlikely for PTS with the overall consequence to the species being Minor. The overall risk level to mid frequency cetaceans from piling driving is Low for PTS and Medium for TTS occurrence.

High frequency cetaceans and pile driving

The only species classified as a high frequency cetacean occurring in the vicinity of the Project is the Harbor Porpoise. Harbor porpoises are typically present at the spring and autumn months, corresponding to the start and end of the construction period.

Predicted noise levels from impact piling suggest the TTS criterion to be exceeded for high frequency cetaceans within 95 km of the piling source, and PTS threshold to be exceeded within 23 km of piling (Table C-1). The size of the threshold distances is quite large. However, after considering other qualitative factors such as the short duration of piling activities which also will likely occur outside of Harbor Porpoise season, we consider the Likelihood rating of impact piling affecting high frequency cetaceans to be Likely for TTS and Unlikely for PTS threshold distances. The overall risk level to high frequency cetaceans is Low for PTS and Medium for TTS occurrence.

Table C-1 Summary of pile driving threshold distances for whales, dolphins and porpoises

		LF Cetaceans (Whales)		MF Cetaceans (Dolphins)		HF Cetaceans (Porpoises)	
Activity	**Month**	**PTS Threshold [m]**	**TTS Threshold [m]**	**PTS Threshold [m]**	**TTS Threshold [m]**	**PTS Threshold [m]**	**TTS Threshold [m]**
Impact Piling	May	12,200	64,800	1130	9,470	22,700	94,700
	Oct	9,100	27,900	1040	7,290	14,900	37,200

Seals

Seals are only likely to inhabit the Project area at the beginning and/or end of the construction phase. Harbor, Gray and Harp seals are typically present in the New York Bight in autumn, winter and spring.

Predicted noise levels from impact piling suggest the TTS criterion to be exceeded for seals within 38 km of the piling source, and PTS threshold to be exceeded within 7 km of piling (Table C-2). Piling will occur when numbers are low, and so it is anticipated that noise impacts will be limited to individuals which are transiting the Project area mostly out of season. Also considering the large size of the threshold distances and the short duration of piling activities we consider the Likelihood rating of impact piling affecting seals to be Unlikely for TTS and Rare for PTS with the consequence to the species being Minor. The overall risk level to seals from pile driving is Low for both PTS and TTS occurrence.

Sea turtles

Noise predictions for impact piling underwater noise show the Harassment criterion is exceeded for animals within 1.1 km of piling. (Table C-2). Construction is scheduled during the months of May through October, which is the period with the highest numbers of turtles present in the Project area, and it is noted that turtles will not transit the Project area outside of these months. Piling will only occur for approximately 2.5 hours per pile (if necessary) out of the seven months turtles are present in the New York Bight region, and as such piling noise impacts on turtles will be restricted to this narrow time frame. We have assessed the Likelihood of impact piling causing Harassment to ESA listed turtles as Likely, hence the overall risk level to ESA listed sea turtles from impact piling associated with the Project is Medium for Harassment.

Fish (Atlantic Sturgeon)

Atlantic sturgeon exposed to high levels of underwater noise such as piling driving could experience tissue damage or other physical injury, potentially leading to mortality. Elevated underwater noise levels are anticipated to have a Moderate consequence on Atlantic sturgeon where the Harm criterion is exceeded. The Harm criterion is exceeded within a threshold distance of 13 km from impact piling (Table C-2). Atlantic Sturgeon could transit the Project area year round, and so may potentially be present during impact piling. However, the short duration of piling and transient nature of the fishes movements will limit the potential impact on the species. The Likelihood rating of impact piling affecting Atlantic Sturgeon is therefore considered Unlikely for Harm and so the overall risk level to Atlantic Sturgeon from impact piling associated with the Project is is calculated as Medium.

Table C-2 Summary of pile driving threshold distances for seals, turtles and Atlantic sturgeon

Activity	Month	Seals		Sea Turtles		Fish (Atlantic Sturgeon)	
		PTS Threshold [m]	TTS Threshold [m]	Harm Threshold [m]	Harassment Threshold [m]	Harm Threshold [m]	Harassment Threshold [m]
Impact Piling	May	6,550	3,7200	NA	1,100	12,700	NA
	Oct	5,350	20,700		1,000	9,470	